

The Federal Research and Development Portfolio

Discovery and Innovation

**Federal Research and Development
Activities in the Fifty States,
District of Columbia, and Puerto Rico**

Donna Fossum • Lawrence S. Painter
Valerie Williams • Allison Yezril
Elaine Newton • David Trinkle

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Research and Development in the United States

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**Office of Science and Technology Policy and the
National Science Foundation**



Research and Development in the United States

Science and Technology Policy Institute

RAND

Preface

THIS ANALYSIS

Each year, the U.S. federal government devotes a notable portion of the federal budget to the support of research and development (R&D) activities. Virtually everyone agrees that these functions are critical in driving the nation's economy, as well as determining the personal health and quality of life of its citizens. Unfortunately, most of the currently available information on federally funded R&D activities is too aggregated to be of much use to policymakers or members of the public seeking to evaluate the federal R&D portfolio. The purpose of this report is to begin to remedy that situation.

To make this report as useful as possible to policymakers and the public, the R&D activities of the federal government are described by state. Only by taking this approach—that is, by walking the federal R&D portfolio from the specific locations of individual R&D performers to the national level—can the full scope and impact of federal R&D activities be appreciated. Furthermore, only by detailing federal R&D activities by state can it be demonstrated how absolutely every part of the nation is directly involved in and affected by this vital and enormous enterprise.

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Introduction

BACKGROUND

The importance and value of research and development (R&D) is universally recognized. R&D has a profound impact on every aspect of our lives—affecting the air we breathe, the food we eat, and the water we drink; the ailments we suffer; the way we communicate; and the manner in which we traverse our cities, our planet, and beyond. This national investment in our future also has a major effect on the economy, because entire industries—transportation, pharmaceuticals, computers, telecommunications—are rooted in R&D and its continuing output. The positive impact of R&D investments of the federal government on the U.S. economy is widely recognized by experts and is credited with underpinning much of the nation's economic growth during the 20th century. In short, science and technology are transforming our society, and the U.S. federal government has driven much of that change due to its investments in R&D.

Underlying these global and national trends, however, are local and regional impacts from federal R&D activities that are equally important and of even more direct consequence to Americans. Specific federal R&D activities are often deeply rooted in the communities in which they are conducted. Such activities attract new businesses to these areas, thereby stimulating local economies and improving the quality of local schools. When the locations of federal laboratories and major federally funded R&D activities at universities are mapped with the locations of high-technology start-up companies, the ripple effects of federal R&D investments on regional and local economies become even clearer. Little wonder that states and localities compete with each other to attract federal R&D support to their jurisdictions.

Given the importance of federal R&D investments to the nation, states, and localities, amazingly little information is available about them that is complete, detailed, and current. Print and electronic media provide occasional information on the substance and location of cutting-edge R&D supported by the federal government, but they tend to be cursory and sporadic. National and some state information can be gleaned from the annual data collections of the National Science Foundation (NSF), most particularly NSF's annual *Survey of Federal Funds for Research and Development*. The best attempt to date to sharpen the focus of the federal R&D activities at the state level is found in a series of pamphlets issued between 1996 and 1999 by the American Association for the Advancement of Science (AAAS). This series, *The Future of Science & Technology in the States*, describes some of the major federal R&D activities in selected states and regions of the nation, with a heavy reliance on the NSF survey noted above. In 1996, this series reported on California, Georgia, Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin. In 1997, it reported on Connecticut, Florida, Georgia, Maine, Massachusetts, North Carolina, Oregon, Rhode Island, South Carolina, Vermont, Washington, and Virginia. In 1998, it reported on Arizona and Pennsylvania, and in 1999, it reported on Alabama, Louisiana, and Mississippi.

All of these sources of information have significant limitations, however. Specifically, the R&D activities highlighted in the news media are very selective, focusing on only a few, high-profile areas of R&D. NSF's data, while consistently covering most federal R&D activities, is highly aggregated at the national and international levels and resistant to analysis because it limits the substantive characterization of R&D activities to a general academic field of science or engineering. And AAAS's information is incomplete, mentioning only some of the federally supported R&D activities in a given state and overlooking seven of the top 15 state recipients of federal R&D funds (i.e., the District of Columbia, Maryland, Missouri, New Mexico, New Jersey, New York, and Texas). In addition, much of the information is dated.

Given the importance of federal R&D to the nation, there is an ongoing need for a data system that can provide detailed information on all of these activities as they occur. Recognizing this, the White House

Office of Science and Technology Policy (OSTP) encouraged RAND to develop such a database.

The result of this ambitious undertaking is the Research and Development in the United States (RaDiUS) database, which has made it possible to identify and describe virtually all of the ongoing R&D activities of the federal government by agency, subject, performer, location, and other important criteria (see description in Appendix A). Because the RaDiUS database permits both broad and deep views of the federal R&D portfolio, it allows policymakers and the public, for the first time, to break down the complex federal R&D portfolio into its component state and local elements. While over 30 reports for OSTP and the National Science and Technology Council (NSTC) have to date tapped RaDiUS's potential, this report is by far the most comprehensive use of its extensive capabilities.

OBJECTIVES OF THIS STUDY

This report details the full range of federal R&D activities in terms of the individual laboratories, centers, universities, and companies performing the research, doing the studies, and conducting the analyses. No longer will the view of the federal R&D enterprise be limited to only three general dimensions—the *character* (i.e., stage) of the R&D, the scientific or engineering *field* most closely related to the R&D, and the general *category of performer* of R&D. Instead, we can put a human face on it—the office down the road where a friend is employed, the university where a student attends class, and the field station on the mountainside where the forest researcher works. The significance of individual federal R&D activities can now be better understood on a local basis and their true impact brought home to every community in the nation. Although this report shows that federal R&D activities are heavily concentrated in a few regions of the country, it also reveals that virtually every community in the nation has a direct stake in the federal R&D enterprise. Changes in the scope and activities of our national R&D enterprise can now be evaluated in terms of their impact on the local, as well as the national, economy. At the same time, the role that federal R&D activities play in state and local economic development can also begin to be seen in greater detail.

This report was prepared to provide an appreciation of the true scope of the federal R&D enterprise and the challenge of coordinating and managing such an expansive endeavor. In addition, by revealing the qualitative differences between the various activities in the federal R&D portfolio, this report shows with greater clarity than previously available how some of these activities focus on applying the information obtained in prior discoveries and preserving the gains R&D has already brought us, while others seek to push the envelope of knowledge far beyond anything yet imagined. All too often, the emphasis on cutting-edge R&D breakthroughs results in all other R&D activities being undervalued. Hopefully, this report will help to correct this tendency, because both types of R&D are essential.

At the outset, several cautionary points must be made. First, some information in this report will likely prompt questions because it is presented in a different manner. Specifically, the contents of the federal R&D portfolio are described in this report, for the first time, in terms of the actual legal ground rules and conditions under which the R&D work is being conducted (i.e., work performed by federal employees, federal contractors, or federal grant and cooperative agreement recipients). Previous reports focused only on the status of the performing entities (e.g., universities, nonprofits, industry), making no allowance for the fact that frequently these entities are simultaneously conducting federal R&D under the markedly different terms of contracts, grants, and cooperative agreements. The RaDiUS database has made it possible to draw these critical distinctions. In addition, since RaDiUS looks at the substantive focus of the R&D activity, rather than the academic field of the researcher doing the work, it is possible to determine which federal agencies are examining similar R&D topics. These common R&D efforts, several of which are outlined below in Figure S.2, do not necessarily indicate duplicative or redundant R&D activities, and the reader is cautioned not to conclude that they do. Instead, RaDiUS reveals the complementary nature of the R&D activities of federal agencies.

Still other data will reveal the shortcomings of the underlying material upon which it is based. This is to be expected in an undertaking of this size and scope that attempts to gather specific information

from all R&D agencies and bureaus in the federal government. Every attempt has been made to avoid errors, especially double-counting of federal R&D funding and the allocation of personnel between related units and sub-units and programs spanning more than one state and/or city. Under no circumstances should this report be viewed as an accounting or financial management document. Throughout the preparation of this report, decisions had to be made regarding which details to present about every federal R&D unit. Space limitations in this report have caused the mass of data contained in the RaDiUS database to be presented in summary form. As a result, individual activities at specific institutions have had to be combined in many cases. Clearly, opinions will differ as to what is most important and/or representative about a particular unit. All decisions regarding the content of this report were made with the objective of spotlighting actual R&D activities, rather than simply iterating official mission statements. The reader is specifically cautioned against comparing the funding and personnel levels among various R&D units in this report. Some units have large funding-to-personnel ratios, while others do not. These differences are attributable to a variety of factors (e.g., equipment and facilities costs), none of which involve the inefficient operation of a research unit. And finally, while this report was prepared at the request and with the support of OSTP, that office is in no way responsible for its contents. The senior author of this report assumes full responsibility for the content of the pages that follow, as well as any errors of commission or omission therein.

STUDY APPROACH AND DATA LIMITATIONS

Scope

This report focuses exclusively on the activities of the U.S. federal government that comprise the federal R&D portfolio. For FY 2001, \$85 billion has been requested for federal R&D activities. The elements of the federal R&D portfolio span 24 federal agencies and annually account for approximately 14 percent of all discretionary

spending of the federal government. Included in these totals are every project, experiment, salary, piece of equipment, or facility charge paid for with federal R&D funds. They include all R&D activities taking place in federal laboratories, some of which are more commonly referred to as “national laboratories,” as well as R&D activities at private companies, colleges, universities, nonprofits, etc., paid for with federal R&D funds.

Identifying Federal R&D

The operative definition of federal R&D used in this report is “all activities that are *paid for* with federal R&D funds.” This definition requires special emphasis because it can easily be read as “all *R&D activities* that are paid for with federal funds.” Distinguishing between these two phrases is critical because of the way these government activities are labeled as R&D.

The official definition of R&D, which applies to all federal agencies, is found in Office of Management and Budget’s (OMB’s) Circular A-11. It distinguishes among the Conduct of R&D, R&D Equipment, and R&D Facilities and states specifically:

Conduct of R&D	Basic Research	Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.
	Applied Research	Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.
	Development	Systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.
R&D Equipment	The acquisition of major equipment for R&D. Includes expendable or movable equipment (e.g., spectrometers, microscopes) and office furniture and equipment. Routine purchases of ordinary office equipment or furniture and fixtures are normally excluded.	
R&D Facilities	The construction and rehabilitation of R&D facilities. Includes the acquisition, design, and construction of, or major repairs or alterations to all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the government or by a private organization, and regardless of where title to the property may rest. Includes such fixed facilities as reactors, wind tunnels, and particle reactors. Excludes movable R&D equipment.	

While this definition of federal R&D appears clear and concise on its face, it is interpreted and applied differently by a wide range of people located in dozens of offices throughout the federal government. Because of the varying interpretations, a specific activity that is considered R&D by a person in one federal agency may not be similarly considered R&D by a person in another federal agency. The nature, magnitude, and significance of these variations have never been explored or discussed, however, because the myriad individual activities that ultimately end up being included in the federal R&D portfolio have never been systematically identified. The RaDiUS database has identified in detail all of the activities—and only those activities—the costs of which have been paid for with federal R&D dollars. In so doing, the RaDiUS database allows comparisons of federally supported R&D activities to be made reliably across the entire federal government. The process of building this database, however, has also uncovered a number of inconsistencies with regard to what has been officially reported as federal R&D.

For example, while many outside the Department of Commerce (DOC) have long considered the activities of the Manufacturing Extension Program (MEP) to be R&D, the DOC does not. A more subtle inconsistency is evident in the treatment by various agencies of the data gathering, study, and analysis activities conducted in support of federal standard setting. In some agencies (e.g., DOC), these activities appear to be consistently defined as R&D. In others (e.g., the Department of Health and Human Services (HHS) and the Environmental Protection Agency (EPA)), they do not. In still other agencies, it appears that R&D is only envisioned as basic laboratory science; hence, the definition of R&D is narrowly construed (e.g., by the NSF).

While not central to this report, it is worthwhile to note that the lack of uniformity in applying the definition of federal R&D among agencies is perhaps most apparent when it involves distinguishing among the various stages (i.e., character) of R&D—Basic Research versus Applied Research versus Development. Specifically, the dividing line between Basic Research and Applied Research seems to shift depending on whether the judging unit is a “pure science” agency (e.g.,

NSF) or a “mission” agency (e.g., the Departments of Defense (DOD), Agriculture (USDA), and Transportation (DOT), and the Smithsonian Institution). These latter differences do not affect the content of this report, however, because every federal R&D activity is included regardless of its stage or character. Suffice it to say that the uniform application of the definition of R&D and its components is important as federal R&D policies are formulated and resources are allocated using these definitions.

R&D Versus S&T

By far, the biggest challenge in creating the RaDiUS database, as well as preparing this report, has been to accurately distinguish the R&D activities from the science and technology (S&T) activities of the federal government. Although there is a government-wide definition of R&D, there is no comparable government-wide definition of S&T. Indeed, as discussed below, the term “S&T” has at least two conflicting meanings. Further complicating the picture is the fact that, although these terms have been used interchangeably for years, they do not refer to the same set of activities. Specifically, for the military portion of the federal government, S&T activities are a subset of R&D activities. In contrast, for the civilian portion of the federal government, R&D activities are a subset of S&T activities.

To better manage its portion of the federal R&D portfolio and reflect the fact that it engages in a range of R&D activities that other agencies tend not to, DOD subdivides the “D” portion of R&D into seven categories (see Appendix B). DOD then takes one of these subcategories of development (i.e., 6.3) and groups it with Basic Research (i.e., 6.1) and Applied Research (i.e., 6.2) and calls the trio S&T. In so doing, DOD officially renders S&T a subset of R&D for all military activities of the federal government. Hence, this report covers all R&D and S&T activities of the military portion of the federal government.

For the civilian side of the federal government, however, some S&T activities are not simultaneously designated as R&D activities. Specifically, for three civilian agencies—the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and

NSF—a substantial portion of their activities falls within a function category officially known as General Science, Space, and Technology (Budget Function 250). This category is generally referred to as the S&T function in the federal budget. As a result, most, if not all, of the activities that fall within this budget function are commonly referred to as S&T. Only a portion of the activities contained in the S&T Budget Function, however, are defined as R&D. Hence, because of the interplay between two coexisting sets of definitions, R&D activities are a subset of S&T activities for NASA, DOE, and NSF. A similar phenomenon occurs for parts of DOC and EPA, where specific budget accounts carry S&T labels, yet only a portion of their contents are designated as R&D. This pattern appears to prevail for all civilian agencies in the federal government, although for most, the extent of their S&T activities is more difficult to determine because they fall into function categories not specifically labeled S&T. Because R&D is a subset of S&T for the civilian portion of the federal government, this report does not cover all civilian S&T activities. With two exceptions (the Science and Technology Policy Institute and the Center for Strategic Tax Administration Modernization), this report covers only the civilian S&T activities of the federal government that are also designated to be R&D activities.

All of these examples of “R&D-like” activities excluded from the federal R&D portfolio are indeed S&T activities that reside in the “halo” around the civilian R&D category depicted in Figure S.1. A large share of the time involved in preparing this report has been devoted to identifying the precise boundary between the R&D and the S&T activities in each of the civilian agencies in the federal government. Often the actual performers themselves of a specific federal activity could not pinpoint which side of the R&D versus S&T definition line they were on. In such cases, through a series of conversations, e-mail exchanges, and faxes, the funding of the activity in question was traced and its proper designation ultimately confirmed by the budget office of the appropriate federal agency. As a result of this effort, we are confident that this report includes only those activities that are a part of the federal R&D portfolio. A similar process was used to distinguish as clearly as possible the portion of each civilian facility’s activities that were R&D as opposed to only S&T.

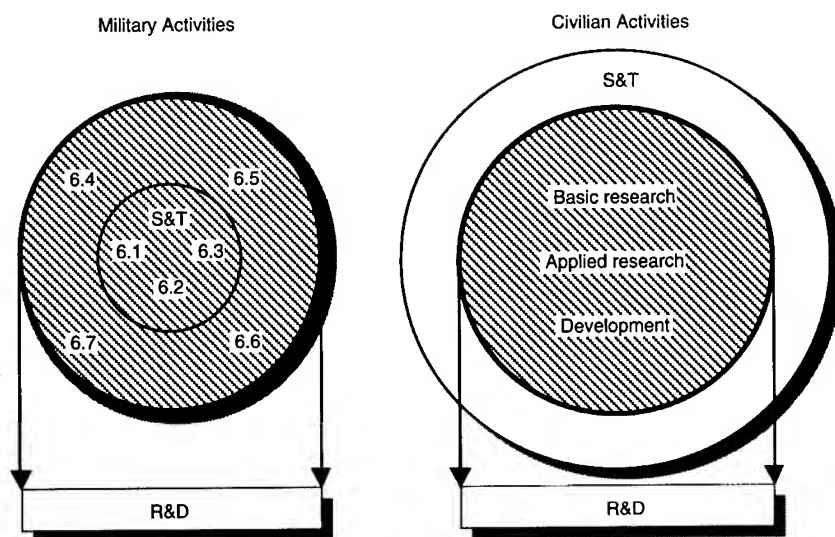


Figure S.1 – R&D Versus S&T

Assessing Current Data Limitations

The best available information until now on the overall contents of the federal R&D portfolio has been compiled by NSF. It does not permit the federal R&D portfolio to be broken out into operationally meaningful substantive or technical areas, however, because it describes all federal R&D activities only in terms of the general scientific field or discipline involved. By categorizing activities in this manner, rather than by the goal or objective of the research, it is difficult to support many of the detailed analyses required by policymakers and the public to evaluate the specific contents of the federal R&D portfolio. In addition, these data do not identify the general ground rules under which federally supported R&D is conducted, that is, whether the R&D is performed under the terms and conditions of a grant, contract, or cooperative agreement. As a consequence, who controls the R&D work, who owns any resulting intellectual property, and who has title to any acquired equipment cannot be considered in any analyses.

NSF's surveys describe the substance of the entire federal R&D portfolio only in terms of the scientific or engineering *field* (i.e., disci-

pline) most closely related to the R&D. Specifically, they note only whether the R&D activities relate to life sciences, psychology, physical sciences, environmental sciences, mathematics and computer sciences, engineering, social sciences, other sciences, or development. When compiled, these data show that virtually every federal R&D agency is involved in almost every field of science and engineering. Such information is of little use in identifying specific areas of common interest among federal R&D agencies and helping them coordinate their R&D activities. To do this, the federal R&D portfolio must be examined in finer detail by specific substantive or technical area.

A fresh approach, made possible by the magnification capabilities of the RaDiUS database, is illustrated in Figure S.2. It compares the two dozen federal R&D agencies with some of their current R&D focus areas. Although many federal agencies share a common interest in particular areas of R&D, a review indicates there is little duplication of R&D effort among federal agencies. Instead, various agencies are tackling different aspects of a common problem. For example, while HHS is clearly the center of federal cancer research, its activities focus on identifying the molecular and genetic mechanisms that cause cancer and searching for chemical compounds to treat it. At the same time, EPA studies the connection between environmental estrogens and cancer and NASA explores the production of anti-cancer drugs in microgravity. NSF develops statistical models to determine cancer risks and machines to microscopically image cancer, DOD explores the connection between Persian Gulf War service and exposure to jet fuel and the incidence of cancer, and USDA studies human diets and cancer risk factors and the potential for growing a sufficient amount of a cancer-fighting plant to guarantee a supply for cancer patients. Meanwhile, the Department of Veterans Affairs (DVA) studies the efficacy of a variety of cancer treatments in clinical settings and DOE explores the possibility of using radioisotopically altered antibodies and neutron radiotherapy to treat cancer. The existence of RaDiUS has enabled researchers in different federal agencies to learn of work on related R&D problems being tackled by other agencies. In addition, such information helps federal agencies to better plan and leverage their R&D investments.

Focus Area*	DOD	HHS	NASA	DOE	NSF	USDA	DOC	DOT	EPA	DOI	DVA	DEED	AID	SMITH	DOL	DOJ	USPS	NRC	HUD	TVA	SSA	TREAS	ACDA	MMC
Cancer	X	X	X	X	X	X	X		X		X			X										
Elderly	X	X			X	X	X		X		X	X												
Flood	X		X		X	X	X	X	X	X										X				
Fuel Cell	X	X	X	X	X	X		X			X													
HIV	X	X		X	X	X	X				X	X	X			X								
Hazardous Waste	X	X	X	X	X	X	X	X	X	X														
Homeless		X			X	X					X				X				X					
MRI	X	X	X	X	X	X	X				X	X		X										
Optical	X	X	X	X	X	X	X	X			X			X			X							
Pesticide	X	X			X	X	X		X				X											
Remote Sensing	X	X	X	X	X	X	X	X	X	X				X										
Seismic	X	X	X	X	X	X	X	X		X								X						
Substance Abuse	X	X			X	X		X			X					X					X			
Titanium	X	X	X	X	X	X	X	X		X	X													
Violence	X	X			X	X					X					X								
Wheat		X	X	X	X	X	X				X													

* All information was obtained by searching RaDiUS using the specific terms noted, with one exception. The search for "substance abuse" also includes the term "chemical abuse."

** As of FY 2000, ACDA ceased to categorize any of its activities as R&D.

NOTE: While many federal agencies may share a common interest in particular areas of R&D, there is little duplication of R&D effort among federal agencies. Instead, various agencies are tackling different aspects of a common problem.

Figure S.2 – Federal Agencies Supporting R&D Related to Focus Area

NSF's surveys also divide the federal R&D portfolio according to the *category of performer of R&D* (i.e., a general description of the parties performing the R&D). That is, they note whether the R&D work is conducted intramurally by federal employees or extramurally by industrial firms, colleges or universities, nonacademic nonprofits, state or local governments, or federally funded research and development center (FFRDCs). The view of the federal R&D portfolio provided by this cross section of the data is perhaps the most problematic, because it focuses on the legal status of federal R&D performers rather than the legal terms and conditions under which federal R&D work is actually conducted. While these matters are related, they are far from synonymous. Indeed, it is quite common for a single type of R&D performer (e.g., a university) to simultaneously have R&D grants, R&D contracts, and R&D cooperative agreements from the federal government. Consequently, the legal terms and conditions under which

federal R&D work is performed are critical, because they enable an observer to know who controls the conduct of the R&D work, who owns the results of the R&D work, and who owns any R&D equipment purchased in the course of doing the work.

For federal R&D conducted intramurally, the work is clearly controlled by the federal government, the results are definitely owned by the federal government, and all equipment acquired during the course of the work is the property of the federal government. For federal R&D conducted extramurally, however, depending on the type of legal instrument used by the federal government to transfer the federal R&D dollars to the extramural performer, who controls the conduct of the R&D and who owns the results of the R&D can differ markedly. Similarly, who ends up owning any equipment purchased during the course of the R&D work depends on the precise terms of each specific legal instrument.

The legal instruments that transfer federal R&D dollars to extramural performers are grants, contracts, and cooperative agreements. Each of these specifies a different set of terms and conditions under which the extramural R&D is to be performed. Contracts are used by federal agencies to get R&D work performed that satisfies a specific need of the federal government. A contract specifies the nature of the R&D work to be performed, the manner in which the R&D work will be conducted, and the penalties that will result if the R&D work is not performed as stipulated. Grants and cooperative agreements are used to transfer federal R&D dollars when federal agencies want to achieve a public purpose rather than fulfill specific needs of the federal government. A grant is used when the agency does not expect to be substantially involved in the R&D effort, while a cooperative agreement is used when a federal agency expects to be substantially involved in the R&D effort. Neither instrument specifies the manner in which the work is to be performed and no penalties result under either a grant or a cooperative agreement for failure to perform the work.

The type of legal instrument used by agencies to transfer federal R&D dollars to extramural performers differs markedly from one agency to another, as well as across programs within an agency. For example, DOD, NASA, and DOE favor the use of contracts to transfer

R&D funds to extramural performers, while HHS and NSF favor the use of grants. The primary user of cooperative agreements is USDA. About 75 percent of all federal R&D dollars are transferred each year to extramural performers—60 percent through contracts, 35 percent through grants, and 5 percent through cooperative agreements. Given the significance of these legal instruments in determining the terms and conditions under which federal R&D is performed, they are a central organizing theme of this report.

HOW THIS REPORT IS ORGANIZED

The body of this report consists of 52 chapters that describe the federal R&D activities that take place in the 50 states, the District of Columbia, and Puerto Rico (hereinafter collectively referred to as “states”). Each of the chapters begins with a general overview of federal R&D activities in the state, followed by sections describing the federal R&D units in the state, the federal R&D grants awarded to entities located in the state, and any other federal R&D activities involving entities located in the state.

Specifically, the profile of every state begins with an estimate of the total federal R&D dollars spent in the state, the proportion of all direct federal dollars received by the state that are R&D dollars, and where the state ranks in terms of federal R&D dollars received. It also includes a summary of which federal agencies fund R&D activities in the state and which federal R&D facilities are located in the state. Because complete expenditure information did not become available for Fiscal Year (FY) 1999 until after this report was completed, the focus year of this report is FY 1998. In several instances when it was known that federal R&D units were opening or closing in FY 1999, that information has been included in this report. The estimates of total spending by state are based on federal R&D obligations for Fiscal Years 1993 through 1998 reported to NSF by 10 of the 24 federal R&D agencies. While alternatives were considered, this was found to be the only information source available that consistently included the salaries of federal R&D personnel. A detailed explanation of the limitations with

these data, how they were addressed, and how these estimates were derived is provided in Appendix C. These estimates were used to determine the rankings of the states. The information on the total dollars received by each state from the federal government was obtained from the *Consolidated Federal Funds Report* prepared annually by the Bureau of the Census in the Department of Commerce (Table 1 of the Summary of Federal Government Expenditures, by State and Outlying Area: Fiscal Year 1998). This detail was included to provide a uniform gauge across states of the significance that federal R&D activities play in the overall context of all the direct federal support provided annually to each state.

Following the introductory and background material for each state are three sections that describe the specific federal R&D activities taking place in each state. The first describes the substance and location of all federal R&D units in each state, and covers all R&D units owned by the federal government and staffed by federal employees and/or uniformed military. Because FFRDCs are contractor-operated units established by the federal government to meet special long-term R&D needs that cannot be met effectively by existing federal in-house or conventional contractor resources, FFRDCs are also included in this section. This section does not include government-owned, contractor-operated R&D units that are not FFRDCs. Such units are conventional contract operations and, therefore, are discussed in the portion of the third section of each chapter that describes federal R&D activities performed under contract. All information in the first section is presented alphabetically according to the city in which the federal R&D units are located. To the extent possible, while the headquarters of federal R&D units are duly noted in their proper locations, the separate locations of the many field units, satellite offices, and remote facilities that collectively make up these major federal R&D units are also noted. When appropriate, military R&D units are listed under the cities to which they are immediately adjacent. To the extent practicable, all the subunits of a federal R&D unit are included in the states in which they are respectively located.

While a substantial portion of the information presented in the first section comes directly from the individual R&D units and/or their web-

sites, some comes from the RaDiUS database. To ensure that the funding and staffing information for individual R&D units was accurate, it was obtained directly in most cases from the central budget and finance offices of federal agencies and bureaus or directly from individual R&D units. While every effort was made to obtain comparable funding and staffing information for every R&D unit, it ultimately proved impossible to totally overcome the unevenness of the available data. As a result, while in most cases the funding provided is obligations, in a few it is outlays or budget authority. All funding amounts should therefore be considered estimates. Similarly, some staffing figures are head counts, while others are FTEs. With minor exception, all funding amounts are only for R&D activities that actually take place on the premises of the unit described. It is important to note that several of DOE's laboratories also regularly conduct a significant amount of R&D work for other federal agencies. This "reimbursable" R&D work is not reflected in the funding amounts shown for these units, however, because that would result in double counting. The information provided for each DOD unit does include the reimbursable work performed for other DOD units, as this is the standard way in which R&D funding is tracked throughout DOD. Because the same definition was uniformly applied to all DOD units, no DOD R&D funds were simultaneously credited to the accounts of two different DOD units; hence, none of these funds were double counted.

Considerable effort was taken to describe accurately which type of staffing figures is presented to minimize the chances of misleading the reader. Furthermore, the reader is cautioned not to assume that all funding presented for a particular unit covers only the salaries of staff because many units also spend a significant portion of their R&D funds on equipment and special facilities. To the extent possible, this fact is noted in the information provided on individual units. In addition, while figures for military staff are not included for DOD units, the reader can safely assume that there is at least some military staff present at all DOD R&D units. As noted previously, great care has been taken to distinguish between the R&D and S&T activities of civilian R&D units. In addition, extraordinary efforts have been made to

avoid double counting of any kind and to verify and validate all information presented.

The second section describes the federal R&D activities conducted in each state funded through federal grants. Because a few agencies do not report the specific dollar amount associated with absolutely every grant they award (e.g., USDA), the funding amounts presented in the table in this section should be considered conservative estimates. The third section describes the federal R&D activities that are funded through contracts and cooperative agreements. With minor exceptions, all of the information presented in both sections comes exclusively from the RaDiUS database. Detailed information on every grant, contract, and cooperative agreement referenced in the text and tables of these two sections is available in the RaDiUS database. For example, a search of RaDiUS reveals that an institution like Pennsylvania State University had over 1,300 active federal grants, contracts, and cooperative agreements from over a dozen federal agencies in a recent year. Among these awards were ones from DOC's Sea Grant program, USDA's National Research Initiative, DOD's Defense Advanced Research Projects Agency, DOE's Fossil Energy program, NSF's Engineering program, HHS's National Institutes of Health, DOI's U.S. Geological Survey, NASA's Aeronautical Research and Technology program, and DOJ's Justice Assistance program. Because of obvious space limitations, however, this report provides only summary data and selected details of the information contained in the RaDiUS database on federal R&D grants, contracts, and cooperative agreements.

Summary Tables

The following tables provide summary information on the federal R&D funds received in FY 1998 by the states. Please note that the information presented in the tables is specifically intended to permit comparisons among the states along relevant but quite different dimensions.

Each of the tables contains identical information that has been ordered differently. Specifically, the first column on each table lists the states. The second column contains estimates of the total R&D outlays made in FY 1998 by the federal government to the states. The third column provides the ranking of the states according to the estimated federal R&D outlays contained in the second column. The fourth column provides the total federal funds received by states in FY 1998 that were not mandatory payments made by the federal government to specific individuals residing in the state (i.e., were not entitlements, such as Social Security, Medicare, and disability payments). The fifth column is the percentage of the federal nonentitlement funds received by the states in FY 1998 that were R&D dollars (i.e., the second column divided by the fourth column multiplied by 100). The sixth column is the total number of people residing in the states in FY 1998. The last column is the amount of federal R&D dollars received in FY 1998 for each person residing in the various states (i.e., the second column divided by the sixth column).

The first table lists the states alphabetically. The second table ranks the states according to the total R&D outlays made in FY 1998 by the federal government to the states. The third table ranks the states according to the percent that R&D comprises of the total federal funds received by states in FY 1998 that were not mandatory payments made by the federal government to specific individuals residing in the

state (i.e., were not entitlements, such as Social Security, Medicare, and disability payments). Finally, the fourth table ranks the states according to the amount of federal R&D dollars received in FY 1998 for each person residing in the various states (i.e., federal R&D dollars per capita).

Table S.1 – States Listed Alphabetically

State (including DC and PR)	Estimated Federal R&D Outlays in FY 1998 (000's)	Rank by Estimated R&D Dollars Received	Total Non- Entitlement Federal Funds Received in FY 1998 (000's)	% R&D of Total Federal Funds	Resident Population in FY 1998	Federal R&D Dollars Per Capita
Alabama	2,354,882	11	10,209,000	23	4,351,999	541
Alaska	134,847	41	3,572,000	4	614,010	220
Arizona	861,820	20	10,473,000	8	4,668,631	185
Arkansas	119,595	42	3,969,000	3	2,538,303	47
California	14,420,247	1	74,799,000	19	32,666,550	441
Colorado	1,422,677	16	10,844,000	13	3,970,971	358
Connecticut	819,497	22	8,824,000	9	3,274,069	250
Delaware	59,811	47	1,260,000	5	743,603	80
District of Columbia	2,688,207	10	20,737,000	13	523,124	5,139
Florida	3,173,704	7	25,144,000	13	14,915,980	213
Georgia	4,428,750	4	16,820,000	26	7,642,207	580
Hawaii	223,150	37	4,800,000	5	1,193,001	187
Idaho	273,549	32	2,726,000	10	1,228,684	223
Illinois	1,366,250	17	20,222,000	7	12,045,326	113
Indiana	474,974	26	8,302,000	6	5,899,195	81
Iowa	251,820	35	4,295,000	6	2,862,447	88
Kansas	165,404	39	4,930,000	3	2,629,067	63
Kentucky	112,498	43	10,574,000	1	3,936,499	29
Louisiana	244,331	36	9,061,000	3	4,368,967	56
Maine	78,985	46	3,375,000	2	1,244,250	63
Maryland	8,078,434	2	23,481,000	34	5,134,808	1,573
Massachusetts	3,610,561	6	16,310,000	22	6,147,132	587
Michigan	827,266	21	13,303,000	6	9,817,242	84
Minnesota	652,853	24	7,698,000	8	4,725,419	138
Mississippi	321,814	30	6,138,000	5	2,752,092	117
Missouri	1,441,134	15	14,461,000	10	5,438,559	265
Montana	79,650	45	2,129,000	4	880,453	90
Nebraska	93,019	44	2,961,000	3	1,662,719	56
Nevada	380,036	27	2,721,000	14	1,746,898	218
New Hampshire	270,182	33	2,014,000	13	1,185,048	228
New Jersey	1,522,965	14	14,657,000	10	8,115,011	188
New Mexico	2,307,407	13	7,897,000	29	1,736,931	1,328
New York	2,937,583	8	41,301,000	7	18,175,301	162
North Carolina	922,825	19	14,030,000	7	7,546,493	122
North Dakota	58,242	49	1,879,000	3	638,244	91
Ohio	2,738,664	9	18,343,000	15	11,209,493	244
Oklahoma	164,666	40	7,077,000	2	3,346,713	49
Oregon	320,120	31	5,474,000	6	3,281,974	98
Pennsylvania	2,347,373	12	22,850,000	10	12,001,451	196
Puerto Rico	58,810	48	5,008,000	1	3,860,091	15
Rhode Island	515,347	25	2,396,000	22	988,480	521
South Carolina	204,764	38	8,260,000	2	3,835,962	53
South Dakota	39,317	52	1,832,000	2	738,171	53
Tennessee	707,956	23	13,259,000	5	5,430,621	130
Texas	4,021,787	5	40,866,000	10	19,759,614	204
Utah	376,776	28	4,299,000	9	2,099,758	179
Vermont	58,114	50	1,235,000	5	590,883	98
Virginia	4,592,915	3	34,306,000	13	6,791,345	676
Washington	1,254,429	18	14,954,000	8	5,689,263	220
West Virginia	260,775	34	3,827,000	7	1,811,156	144
Wisconsin	375,793	29	7,456,000	5	5,223,500	72
Wyoming	40,783	51	1,401,000	3	480,907	85

The information in Columns 4 and 6 is from the *Consolidated Federal Funds Report: 1998* issued in April 1999 by the Census Bureau in the Department of Commerce.

Table S.2 – States Ranked by Amount of Federal R&D Funds Received

State (including DC and PR)	Estimated Federal R&D Outlays in FY 1998 (000's)	Rank by Estimated R&D Dollars Received	Total Non- Entitlement Federal Funds Received in FY 1998 (000's)	% R&D of Total Federal Funds	Resident Population in FY 1998	Federal R&D Funds Per Capita
California	14,420,247	1	74,799,000	19	32,666,550	441
Maryland	8,078,434	2	23,481,000	34	5,134,808	1,573
Virginia	4,592,915	3	34,306,000	13	6,791,345	676
Georgia	4,428,750	4	16,820,000	26	7,642,207	580
Texas	4,021,787	5	40,866,000	10	19,759,614	204
Massachusetts	3,610,561	6	16,310,000	22	6,147,132	587
Florida	3,173,704	7	25,144,000	13	14,915,980	213
New York	2,937,583	8	41,301,000	7	18,175,301	162
Ohio	2,738,664	9	18,343,000	15	11,209,493	244
District of Columbia	2,688,207	10	20,737,000	13	523,124	5,139
Alabama	2,354,882	11	10,209,000	23	4,351,999	541
Pennsylvania	2,347,373	12	22,850,000	10	12,001,451	196
New Mexico	2,307,407	13	7,897,000	29	1,736,931	1,328
New Jersey	1,522,965	14	14,657,000	10	8,115,011	188
Missouri	1,441,134	15	14,461,000	10	5,438,559	265
Colorado	1,422,677	16	10,844,000	13	3,970,971	358
Illinois	1,366,250	17	20,222,000	7	12,045,326	113
Washington	1,254,429	18	14,954,000	8	5,689,263	220
North Carolina	922,825	19	14,030,000	7	7,546,493	122
Arizona	861,820	20	10,473,000	8	4,668,631	185
Michigan	827,266	21	13,303,000	6	9,817,242	84
Connecticut	819,497	22	8,824,000	9	3,274,069	250
Tennessee	707,956	23	13,259,000	5	5,430,621	130
Minnesota	652,853	24	7,698,000	8	4,725,419	138
Rhode Island	515,347	25	2,396,000	22	988,480	521
Indiana	474,974	26	8,302,000	6	5,899,195	81
Nevada	380,036	27	2,721,000	14	1,746,898	218
Utah	376,776	28	4,299,000	9	2,099,758	179
Wisconsin	375,793	29	7,456,000	5	5,223,500	72
Mississippi	321,814	30	6,138,000	5	2,752,092	117
Oregon	320,120	31	5,474,000	6	3,281,974	98
Idaho	273,549	32	2,726,000	10	1,228,684	223
New Hampshire	270,182	33	2,014,000	13	1,185,048	228
West Virginia	260,775	34	3,827,000	7	1,811,156	144
Iowa	251,820	35	4,295,000	6	2,862,447	88
Louisiana	244,331	36	9,061,000	3	4,368,967	56
Hawaii	223,150	37	4,800,000	5	1,193,001	187
South Carolina	204,764	38	8,260,000	2	3,835,962	53
Kansas	165,404	39	4,930,000	3	2,629,067	63
Oklahoma	164,666	40	7,077,000	2	3,346,713	49
Alaska	134,847	41	3,572,000	4	614,010	220
Arkansas	119,595	42	3,969,000	3	2,538,303	47
Kentucky	112,498	43	10,574,000	1	3,936,499	29
Nebraska	93,019	44	2,961,000	3	1,662,719	56
Montana	79,650	45	2,129,000	4	880,453	90
Maine	78,985	46	3,375,000	2	1,244,250	63
Delaware	59,811	47	1,260,000	5	743,603	80
Puerto Rico	58,810	48	5,008,000	1	3,860,091	15
North Dakota	58,242	49	1,879,000	3	638,244	91
Vermont	58,114	50	1,235,000	5	590,883	98
Wyoming	40,783	51	1,401,000	3	480,907	85
South Dakota	39,317	52	1,832,000	2	738,171	53

The information in Columns 4 and 6 is from the *Consolidated Federal Funds Report: 1998* issued in April 1999 by the Census Bureau in the Department of Commerce.

Table S.3 – States Ranked by Percentage of Federal Funds Received That Are R&D

State (including DC and PR)	Estimated Federal R&D Outlays in FY 1998 (000's)	Rank by Estimated R&D Dollars Received	Total Non- Entitlement Federal Funds Received in FY 1998 (000's)	% R&D of Total Federal Funds	Resident Population in FY 1998	Federal R&D Dollars Per Capita
Maryland	8,078,434	2	23,481,000	34	5,134,808	1,573
New Mexico	2,307,407	13	7,897,000	29	1,736,931	1,328
Georgia	4,428,750	4	16,820,000	26	7,642,207	580
Alabama	2,354,882	11	10,209,000	23	4,351,999	541
Massachusetts	3,610,561	6	16,310,000	22	6,147,132	587
Rhode Island	515,347	25	2,396,000	22	988,480	521
California	14,420,247	1	74,799,000	19	32,666,550	441
Ohio	2,738,664	9	18,343,000	15	11,209,493	244
Nevada	380,036	27	2,721,000	14	1,746,898	218
New Hampshire	270,182	33	2,014,000	13	1,185,048	228
Virginia	4,592,915	3	34,306,000	13	6,791,345	676
Colorado	1,422,677	16	10,844,000	13	3,970,971	358
District of Columbia	2,688,207	10	20,737,000	13	523,124	5,139
Florida	3,173,704	7	25,144,000	13	14,915,980	213
New Jersey	1,522,965	14	14,657,000	10	8,115,011	188
Pennsylvania	2,347,373	12	22,850,000	10	12,001,451	196
Idaho	273,549	32	2,726,000	10	1,228,684	223
Missouri	1,441,134	15	14,461,000	10	5,438,559	265
Texas	4,021,787	5	40,866,000	10	19,759,614	204
Connecticut	819,497	22	8,824,000	9	3,274,069	250
Utah	376,776	28	4,299,000	9	2,099,758	179
Minnesota	652,853	24	7,698,000	8	4,725,419	138
Washington	1,254,429	18	14,954,000	8	5,689,263	220
Arizona	861,820	20	10,473,000	8	4,668,631	185
New York	2,937,583	8	41,301,000	7	18,175,301	162
West Virginia	260,775	34	3,827,000	7	1,811,156	144
Illinois	1,366,250	17	20,222,000	7	12,045,326	113
North Carolina	922,825	19	14,030,000	7	7,546,493	122
Michigan	827,266	21	13,303,000	6	9,817,242	84
Iowa	251,820	35	4,295,000	6	2,862,447	88
Oregon	320,120	31	5,474,000	6	3,281,974	98
Indiana	474,974	26	8,302,000	6	5,899,195	81
Tennessee	707,956	23	13,259,000	5	5,430,621	130
Mississippi	321,814	30	6,138,000	5	2,752,092	117
Wisconsin	375,793	29	7,456,000	5	5,223,500	72
Delaware	59,811	47	1,260,000	5	743,603	80
Vermont	58,114	50	1,235,000	5	590,883	98
Hawaii	223,150	37	4,800,000	5	1,193,001	187
Alaska	134,847	41	3,572,000	4	614,010	220
Montana	79,650	45	2,129,000	4	880,453	90
Kansas	165,404	39	4,930,000	3	2,629,067	63
Nebraska	93,019	44	2,961,000	3	1,662,719	56
North Dakota	58,242	49	1,879,000	3	638,244	91
Arkansas	119,595	42	3,969,000	3	2,538,303	47
Wyoming	40,783	51	1,401,000	3	480,907	85
Louisiana	244,331	36	9,061,000	3	4,368,967	56
South Carolina	204,764	38	8,260,000	2	3,835,962	53
Maine	78,985	46	3,375,000	2	1,244,250	63
Oklahoma	164,666	40	7,077,000	2	3,346,713	49
South Dakota	39,317	52	1,832,000	2	738,171	53
Puerto Rico	58,810	48	5,008,000	1	3,860,091	15
Kentucky	112,498	43	10,574,000	1	3,936,499	29

The information in Columns 4 and 6 is from the *Consolidated Federal Funds Report: 1998* issued in April 1999 by the Census Bureau in the Department of Commerce.

Table S.4 – States Ranked by Federal R&D Funds Received per Capita

State (including DC and PR)	Estimated Federal R&D Outlays in FY 1998 (000's)	Rank by Estimated R&D Dollars Received	Total Non- Entitlement Federal Funds Received in FY 1998 (000's)	% R&D of Total Federal Funds	Resident Population in FY 1998	Federal R&D Dollars Per Capita
District of Columbia	2,688,207	10	20,737,000	13	523,124	5,139
Maryland	8,078,434	2	23,481,000	34	5,134,808	1,573
New Mexico	2,307,407	13	7,897,000	29	1,736,931	1,328
Virginia	4,592,915	3	34,306,000	13	6,791,345	676
Massachusetts	3,610,561	6	16,310,000	22	6,147,132	587
Georgia	4,428,750	4	16,820,000	26	7,642,207	580
Alabama	2,354,882	11	10,209,000	23	4,351,999	541
Rhode Island	515,347	25	2,396,000	22	988,480	521
California	14,420,247	1	74,799,000	19	32,666,550	441
Colorado	1,422,677	16	10,844,000	13	3,970,971	358
Missouri	1,441,134	15	14,461,000	10	5,438,559	265
Connecticut	819,497	22	8,824,000	9	3,274,069	250
Ohio	2,738,664	9	18,343,000	15	11,209,493	244
New Hampshire	270,182	33	2,014,000	13	1,185,048	228
Idaho	273,549	32	2,726,000	10	1,228,684	223
Washington	1,254,429	18	14,954,000	8	5,689,263	220
Alaska	134,847	41	3,572,000	4	614,010	220
Nevada	380,036	27	2,721,000	14	1,746,898	218
Florida	3,173,704	7	25,144,000	13	14,915,980	213
Texas	4,021,787	5	40,866,000	10	19,759,614	204
Pennsylvania	2,347,373	12	22,850,000	10	12,001,451	196
New Jersey	1,522,965	14	14,657,000	10	8,115,011	188
Hawaii	223,150	37	4,800,000	5	1,193,001	187
Arizona	861,820	20	10,473,000	8	4,668,631	185
Utah	376,776	28	4,299,000	9	2,099,758	179
New York	2,937,583	8	41,301,000	7	18,175,301	162
West Virginia	260,775	34	3,827,000	7	1,811,156	144
Minnesota	652,853	24	7,698,000	8	4,725,419	138
Tennessee	707,956	23	13,259,000	5	5,430,621	130
North Carolina	922,825	19	14,030,000	7	7,546,493	122
Mississippi	321,814	30	6,138,000	5	2,752,092	117
Illinois	1,366,250	17	20,222,000	7	12,045,326	113
Vermont	58,114	50	1,235,000	5	590,883	98
Oregon	320,120	31	5,474,000	6	3,281,974	98
North Dakota	58,242	49	1,879,000	3	638,244	91
Montana	79,650	45	2,129,000	4	880,453	90
Iowa	251,820	35	4,295,000	6	2,862,447	88
Wyoming	40,783	51	1,401,000	3	480,907	85
Michigan	827,266	21	13,303,000	6	9,817,242	84
Indiana	474,974	26	8,302,000	6	5,899,195	81
Delaware	59,811	47	1,260,000	5	743,603	80
Wisconsin	375,793	29	7,456,000	5	5,223,500	72
Maine	78,985	46	3,375,000	2	1,244,250	63
Kansas	165,404	39	4,930,000	3	2,629,067	63
Nebraska	93,019	44	2,961,000	3	1,662,719	56
Louisiana	244,331	36	9,061,000	3	4,368,967	56
South Carolina	204,764	38	8,260,000	2	3,835,962	53
South Dakota	39,317	52	1,832,000	2	738,171	53
Oklahoma	164,666	40	7,077,000	2	3,346,713	49
Arkansas	119,595	42	3,969,000	3	2,538,303	47
Kentucky	112,498	43	10,574,000	1	3,936,499	29
Puerto Rico	58,810	48	5,008,000	1	3,860,091	15

The information in Columns 4 and 6 is from the *Consolidated Federal Funds Report: 1998* issued in April 1999 by the Census Bureau in the Department of Commerce.

Glossary

Applied Research—Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met (see OMB Circular A-11, Section 25 in 1998 and Section 84 in 1999).

Baseline—All funds reported to OMB as being spent on activities that fall within the federal R&D portfolio.

Basic Research—Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind (see OMB Circular A-11, Section 25 in 1998 and Section 84 in 1999).

Budget Authority—The authority provided by law to incur financial obligations that will result in outlays (see OMB Circular A-11 (1999), Part 20).

Budget Function—The classification of budget authority, outlays, and obligations according to the major purpose served by the spending. Examples of budget function categories include agriculture; national defense; transportation; and general science, space, and technology (see OMB Circular A-11, Section 20).

Category of Performer of R&D—Eight general categories used by the National Science Foundation to identify the group, organization, or person conducting R&D for the federal government. The categories of performers are intramural, industrial firm, university and college, other nonprofit institution, FFRDC, state or local government, foreign performers, and private individual.

Character of R&D—The stage of the study or application of knowledge. This implies a linear model of R&D in which basic research leads to applied research, which in turn leads to development (see OMB Circular A-11, Section 25 in 1998 and Section 84 in 1999).

Conduct of R&D—The activities that comprise research (basic and applied) and development, including their administration. Excludes R&D facilities and equipment (see OMB Circular A-11, Section 25 in 1998 and Section 84 in 1999).

Contract—A legal instrument reflecting a relationship between the federal government and a recipient when the principal purpose of the instrument is to acquire property or services for the direct benefit or use of the federal government (see 31 USC 6303).

Cooperative Agreement—A legal instrument reflecting a relationship between the federal government and a recipient when the principal purpose of the relationship is to transfer funds to the recipient to carry out a public purpose of support or simulation authorized by a federal law; and substantial involvement is expected between the federal government and the recipient when carrying out the activity contemplated in the agreement (see 31 USC 6305).

Development—Systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements (see OMB Circular A-11, Section 25 in 1998 and Section 84 in 1999).

Discipline—A field or subfield of science or engineering.

Discretionary spending—Budgetary resources provided in appropriations acts. Excludes mandatory spending (i.e., entitlements) (see OMB Circular A-11 (1999), Part 20).

Entitlements—Payments to any person or government that the federal government is obligated to make to all persons or governments who meet requirements established by law. Examples of entitlements are Social Security, Medicare, and unemployment insurance. Also referred to as mandatory spending (see OMB Circular A-11 (1999), Part 20).

EPSCoR—The Experimental Program to Stimulate Competitive Research was established at NSF to identify, develop, and utilize a state's academic science and technology resources in a way that will support the creation of wealth and enhance the life of the state's citizens. Specifically, EPSCoR stimulates sustainable R&D infrastructure improvements at the state and institutional levels to significantly increase the ability of EPSCoR researchers to compete for federal and private sector R&D funding, and accelerates the movement of EPSCoR researchers and institutions into the mainstream of federal and private R&D support. Only those states that historically receive less federal R&D funding and have a demonstrated commitment to develop their research bases and improve the quality of science and engineering research conducted at their universities and colleges are eligible to participate in EPSCoR. The 19 states currently in EPSCoR are Alabama, Alaska, Arkansas, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, North Dakota, Oklahoma, South Carolina, South Dakota, Vermont, West Virginia, and Wyoming, as well as the Commonwealth of Puerto Rico.

Federally Funded Research and Development Center—FFRDCs are activities sponsored under a broad charter by a federal agency (or agencies) for the purpose of performing, analyzing, integrating, supporting, and/or managing basic or applied research and/or development, and that receive 70 percent or more of their financial support from the federal government. An FFRDC meets some special long-term research or development need that cannot be met as effectively by existing in-house or contractor resources. FFRDCs enable agencies to use private sector resources to accomplish tasks integral to the mission and operation of the sponsoring agency. An FFRDC, to discharge its responsibilities to the sponsoring agency, has access, beyond what is common to the normal contractual relationship, to federal government and supplier data, including sensitive and proprietary data, and to employees and facilities. The FFRDC is required to conduct its business in a manner befitting its special relationship with the federal government, to operate in the public interest, and to have full disclosure of its affairs to the sponsoring agency. It is not the federal government's intent that an FFRDC use its privileged information or access to facilities

to compete with the private sector. However, an FFRDC may perform work for other than the sponsoring agency under the Economy Act, or other applicable legislation, when the work is not otherwise available from the private sector (see Federal Acquisition Regulation, Part 35).

Federal R&D Enterprise—All portions of the federal government involved in facilitating, conducting, and/or supporting federal R&D activities.

Federal R&D Portfolio—All things acquired with federal R&D funds. Specifically, all R&D conducted with federal funds, all equipment acquired with federal R&D funds, and all facilities constructed and/or rehabilitated with federal R&D funds.

Field of science or engineering—Eight broad categories used by the National Science Foundation to identify the substance of all federal R&D activities. The broad fields are life sciences, psychology, physical sciences, environmental sciences, mathematics and computer sciences, engineering, social sciences, and other sciences not elsewhere classified.

Fiscal Year—The federal government's accounting period. It begins on October 1 and ends on September 30 and is designated by the calendar year in which it ends (see OMB Circular A-11 (1999), Part 20).

Formula Grant—A variation of a grant that transfers funds to a state or one of its sub-divisions according to a distribution formula prescribed by law or regulation to support activities of a continuing nature.

Full-time equivalent—FTE is a basic measure of the level of employment. FTEs are the total number of hours worked (or to be worked) divided by the number of compensable hours applicable to a fiscal year (see OMB Circular A-11 (1999), Part 20).

Grant—A legal instrument reflecting a relationship between the federal government and a recipient when the principal purpose of the relationship is to transfers funds to the recipient to carry out a public purpose of support or stimulation authorized by federal law; and substantial involvement is not expected between the federal government

and the recipient when carrying out the activity contemplated in the agreement (see 31 USC 6304).

Obligation—A binding agreement that will result in outlays, immediately or in the future. Budgetary resources must be available before obligations can be incurred legally (see OMB Circular A-11 (1999), Part 20).

Outlay—A payment to liquidate an obligation (other than the repayment of debt). Outlays are the measure of federal government spending (see OMB Circular A-11 (1999), Part 20).

R&D Equipment—Major equipment acquired for R&D. Includes expendable or moveable equipment, for example, spectrometers and microscopes and office furniture and equipment. Routine purchases of ordinary office equipment or furniture and fixtures are normally excluded (see OMB Circular A-11, Section 25 in 1998 and Section 84 in 1999).

R&D Facilities—The construction and rehabilitation of R&D facilities. This includes the acquisition, design, and construction of, or major repairs or alterations to all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the federal government or by a private organization, and regardless of where title to the property may rest. Includes such fixed facilities as reactors, wind tunnels, and particle reactors. Excludes movable R&D equipment (see OMB Circular A-11, Section 25 in 1998 and Section 84 in 1999).

Agency Acronym Table

Federal Research and Development Agencies, Acronyms, and Funding for FYs 1998, 1999, and 2000

Rank According to Total Federal R&D Budget Authority in FY 1998	Federal Agency	Acronym	FY1998		FY 1999		FY2000	
			Total R&D Budget Authority (actual) (000's)	Total R&D Outlays (actual) (000's)	Total R&D Budget Authority (actual) (000's)	Total R&D Outlays (actual) (000's)	Total R&D Budget Authority (estimate) (000's)	Total R&D Outlays (estimate) (000's)
1	Department of Defense	DOD	37,610,000	37,926,000	38,900,000	37,871,000	38,772,000	37,918,000
2	Department of Health and Human Services	HHS	13,860,000	12,685,000	15,797,000	13,992,000	18,063,000	15,776,000
3	National Aeronautics and Space Administration	NASA	9,753,000	10,251,000	9,715,000	9,793,000	9,753,000	9,597,000
4	Department of Energy	DOE	6,483,000	6,730,000	6,992,000	6,858,000	7,091,000	7,314,000
5	National Science Foundation	NSF	2,528,000	2,302,000	2,702,000	2,399,000	2,903,000	2,578,000
6	Department of Agriculture	USDA	1,561,000	1,546,000	1,645,000	1,599,000	1,773,000	1,707,000
7	Department of Commerce	DOC	1,091,000	835,000	1,084,000	852,000	1,073,000	834,000
8	Department of Transportation	DOT	760,000	562,000	786,000	484,000	585,000	504,000
9	Environmental Protection Agency	EPA	636,000	527,000	670,000	597,000	648,000	658,000
10	Department of Interior	DOI	616,000	595,000	652,000	625,000	584,000	554,000
11	Department of Veterans Affairs	DVA	587,000	564,000	644,000	640,000	655,000	646,000
12	Department of Education	DED	208,000	194,000	205,000	196,000	233,000	216,000
13	Agency for International Development	AID	162,000	232,000	189,000	219,000	142,000	179,000
14	Smithsonian Institution	SMITH	134,000	123,000	105,000	100,000	113,000	109,000
15	Department of Labor	DOL	78,000	78,000	69,000	51,000	71,000	78,000
16	Department of Justice	DOJ	61,000	39,000	88,000	44,000	77,000	47,000
17	U.S. Postal Service	USPS	77,000	77,000	67,000	45,000	45,000	45,000
18	Nuclear Regulatory Commission	NRC	52,000	54,000	49,000	48,000	53,000	47,000
19	Department of Housing and Urban Development	HUD	37,000	31,000	58,000	28,000	45,000	53,000
20	Tennessee Valley Authority	TVA	38,000	38,000	34,000	34,000	33,000	33,000
21	Social Security Administration	SSA	18,000	7,000	38,000	11,000	25,000	39,000
22	Department of the Treasury	TREA	13,000	7,000	3,000	3,000	6,000	6,000
23	Marine Mammal Commission	MMC	1,000	1,000	1,000	1,000	1,000	1,000
24	Arms Control and Disarmament Agency*	ACDA	1,000	1,000	1,000	1,000	0	0
TOTAL			76,365,000	75,405,000	80,494,000	76,491,000	82,744,000	78,939,000

* In FY 1999, ACDA became a part of the Department of State. As of FY 2000, the agency ceased to categorize any of its activities as R&D.

All information is from OMB BPS "Max" System. All R&D amounts include Basic Research, Applied Research, Development, R&D Equipment, and R&D Facilities.

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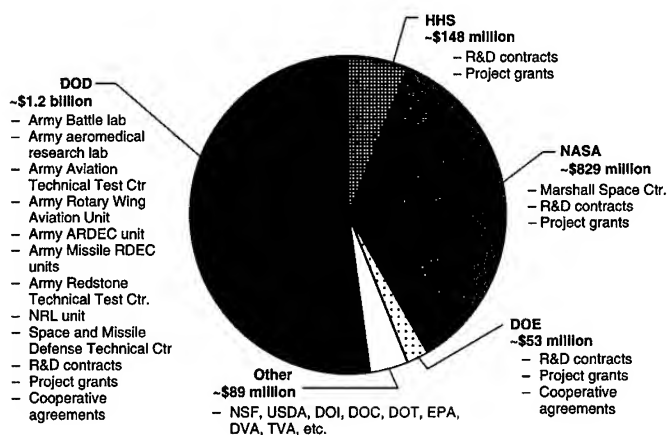
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Chapter 1

Federal Research and Development in Alabama

- Approximately \$2.4 billion of federal R&D funds are spent each year in Alabama.
 - Alabama ranks 11th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
 - Approximately 23 percent of all federal funds spent in Alabama each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.
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**Figure 1.1 – Sources of Federal R&D Dollars Spent in Alabama
(Total Federal R&D ~\$2.4 billion)**

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$2.4 billion annually in Alabama on research and development (R&D) activities. On average, federal R&D dollars account for approximately 23 percent of all federal funds spent in Alabama each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Alabama. Foremost among these agencies is the Department of Defense (DOD), which accounts for 52 percent of all federal R&D dollars spent in the state. The National Aeronautics and Space Administration (NASA) and the Department of Health and Human Services (HHS) account for an additional 35 percent and 6 percent of the federal R&D dollars spent in Alabama, respectively. The remaining federal R&D dollars come collectively from the Departments of Energy (DOE), Agriculture (USDA), and Interior (DOI); the National Science Foundation (NSF); the Environmental Protection Agency (EPA); and several other federal agencies.¹

All federal R&D dollars spent in Alabama either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Alabama.

FEDERAL R&D UNITS IN ALABAMA

Auburn, Alabama, is home to USDA's G. W. Andrews Forestry Sciences Laboratory, Fish Diseases and Parasites Research Laboratory, and National Soil Dynamics Laboratory and DOI's Alabama Cooperative Fish and Wildlife Research Unit.

¹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

- The G. W. Andrews Forestry Sciences Laboratory is a unit of the Southern Research Station inside USDA's Forest Service. It is on the campus of Auburn University. The laboratory conducts research on vegetation management in southern forests and forest engineering. Specific research activities include developing principles and practices for regenerating and managing pines and hardwoods, as well as gathering data on the impacts, fate, and distribution of herbicides in forests. The forest engineering portion of the laboratory focuses on improving forest management through the mechanization of forest operations. It conducts studies to develop more economical harvesting and regeneration systems. The research project on vegetation management and longleaf pine at the laboratory focuses on how to control undesirable vegetation in southern pine and upland hardwood forests, the fate of herbicides in forest ecosystems, and the development of principles and practices for regenerating and managing longleaf pine. This federal R&D unit annually receives approximately \$2.1 million of federal R&D funds and has about 20 employees.
- The Fish Diseases and Parasites Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of Auburn University. It conducts research on the quality of catfish products and on veterinary bacteriology, parasitology, nutrition, and immunology to address the problems in aquaculture that diminish productivity. Specific research activities of this lab include developing vaccines and vaccine delivery systems to prevent diseases and parasite problems; developing rapid diagnostic tests for the earliest intervention against diseases and parasites; and developing catfish diets that will enhance disease and parasite resistance, meet optimal nutritional needs during growing stages, and reduce fish waste in farm ponds. This federal R&D unit, together with the National Soil Dynamics Laboratory described below, annually receives approximately \$3.1 million of federal R&D funds and has about 35 full-time equivalent employees (FTEs).

- The National Soil Dynamics Laboratory is a unit of USDA's ARS located on the campus of Auburn University. It conducts research on developing the knowledge required for managing soil for sustainable and profitable agricultural production. Specifically, it conducts research on tillage, traction, soil compaction, and crop residue management to enhance conservation farming. In addition, the laboratory conducts research on organic wastes to enhance soil quality and soil structure. The funding and staffing information for this federal R&D unit is included in those presented immediately above for the Fish Diseases and Parasites Research Laboratory.
- The Alabama Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). This unit is on the campus of Auburn University. It conducts research on fish and wildlife ecology and investigates the production, utilization, management, protection, and restoration of populations of fish and wildlife. Specific research activities of this unit include assessing flathead channel catfish populations in the Tallapoosa River and examining the effects of surface mine reclamation on aquatic communities. This federal R&D unit annually receives approximately \$177,000 of federal R&D funds and has two FTEs.

Birmingham, Alabama, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Birmingham VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 148 projects with total funding of approximately \$3 million. These R&D activities focus on a wide range of topics, including radiotherapy, drug therapy, neutrophils, HIV, congestive heart failure, and neoplasms.

Dothan, Alabama, is home to DOD's Army Aeromedical Research Laboratory, Army Aviation Technical Test Center, Rotary Wing Aviation Research Unit, and Air Maneuver Battle Laboratory.

- The Army Aeromedical Research Laboratory at Fort Rucker is a unit of DOD. It conducts R&D on the health hazards of Army aviation, tactical combat vehicles, and selected weapon systems; assesses the stress and fatigue of those operating these systems; and designs the criteria on which to base standards for entry and retention in Army aviation specialties. Specific areas of interest include medical study of visual/auditory functions, man-machine integration, physiological responses to operational environments, impact of continuous operations on individual and crew performance, testing of aeromedical evacuation life support equipment, development of improved means of patient evacuation, and airworthiness. This federal unit annually receives about \$5 million of federal R&D funds, virtually all of which are spent on in-house activities, and has a staff of about 80 people, half of whom are civilians.
- The Army Aviation Technical Test Center at Fort Rucker is a unit of DOD. It conducts R&D on the performance, reliability, and maintainability of fixed-wing and rotary-wing aircraft, aircraft components, and related ground support equipment. This federal unit annually receives about \$9.6 million of federal R&D funds, all of which are spent on in-house activities, and has a staff of about 120 people, close to 100 of whom are civilians.
- The Rotary-Wing Aviation Research Unit at Fort Rucker is a unit inside DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are in Orlando, Florida; Fort Benning, Georgia; Fort Knox, Kentucky; Fort Monroe, Virginia; Fort Leavenworth, Kansas; Fort Bragg, North Carolina; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. It conducts research on simulation-based aircrew training. Specific research activities of this unit include researching the best use of flight simulation, part-task trainers, and other information technology tools to improve the efficiency of Army rotary-wing flight training. Through the use of such instructional resources as simulators,

PC-based instructional tools, and part-task training aids, the unit also tries to reduce the heavy reliance on the aircraft as the primary means of pilot training. The program employs a number of research simulation tools, including the Simulator Training Advanced Testbed for Aviation (an Apache flight simulator), a TH-67 low-cost, commercial flight simulator, an OH-58D Kiowa Warrior Simulator and an Intelligent Flight Trainer for the TH-67 aircraft. This federal R&D unit annually receives approximately \$2 million in federal R&D funds, only a portion of which is spent on in-house R&D activities, and has about nine civilians directly involved in R&D activities.

- The Air Maneuver Battle Laboratory at Fort Rucker is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. This laboratory conducts research on advanced concepts and technology relating to the contribution of air maneuver forces and operations. Specific research activities of this laboratory focus on such areas as developing information technologies to support extended range communications, mobile command and control, and tactical reconnaissance. This federal unit annually receives about \$1.3 million of federal R&D funds, only a portion of which is spent in-house, and has six civilian personnel.

Huntsville, Alabama, is home to NASA's George C. Marshall Space Flight Center; and DOD's Army Aviation Research, Development, and Engineering Center; eight directorates and one initiative of the Army Missile Research, Development, and Engineering Center; Redstone Technical Test Center; Space and Missile Defense Technical Center; and Space and Missile Defense Battle Lab.

- The George C. Marshall Space Flight Center is a unit of NASA. It conducts R&D on space propulsion and transportation systems, microgravity, and optics technology. The center also conducts research on global hydrology, astrophysics, and space physics. Among the R&D activities under way at the center are

ones focusing on growing the purest possible protein crystals to advance the design of drugs to fight diabetes, AIDS, emphysema, cancer, and other diseases. Other R&D activities focus on improving the substance and production of inorganic materials with semiconducting, insulating, and/or stabilizing properties that are central to many aspects of modern communication, transportation, and other systems. This federal facility annually receives a total of approximately \$2.3 billion, at least \$687 million of which directly involves R&D efforts. The center has about 2,822 FTEs, only a portion of whom are involved in R&D activities. A substantial portion of its funds is spent on the maintenance and operation of R&D equipment and facilities. In a recent year, over \$275 million of R&D contracts were awarded by the center, about \$58 million of which were made to entities based in Alabama.

- The Army Aviation Research, Development, and Engineering Center is a unit of DOD. Its headquarters and Aviation Engineering Directorate are in Huntsville, Alabama, at the Redstone Arsenal, while its Applied Technology Directorate is in Fort Eustis, Virginia, and its Aeroflight Dynamics Directorate is at Moffett Field, California. The Aviation Engineering Directorate conducts R&D on aviation systems and subsystems, with a specific emphasis on their weaponization. Particular research areas of interest to the directorate include aeromechanics, structures, materials, propulsion, avionics, airworthiness, design integrity, and safety. The directorate is also intensely concerned with aviation mission equipment, integration, and survivability; aviation equipment reliability and maintainability; and aviation ground support. This federal unit annually receives approximately \$9.8 million of federal R&D funds, about \$2.6 million of which are spent on in-house activities, and has about 146 civilian personnel, only a portion of whom are directly involved in R&D activities. The headquarters and administrative units of the center annually receive approximately \$13 million of federal R&D funds, about \$1.9 million of which are spent on in-house

activities, and has about 31 civilian personnel, only a portion of whom are directly involved in R&D activities. In October 1999, the Aviation Research, Development, and Engineering Center was provisionally merged with the Missile Research, Development, and Engineering Center, which is also headquartered in Huntsville.

- The Advanced Systems Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates are also located. This directorate interfaces with the other parts of the Army to determine missile weapon system requirements and with the technology community to determine the status of and to provide future direction regarding R&D in missile technology. This federal unit annually receives about \$11.9 million in federal R&D funds, approximately \$1.4 million of which are spent on in-house activities, and has about 35 civilian personnel, only a portion of whom are directly involved in R&D activities. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.
- The Missile Guidance Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates are also located. This directorate conducts R&D on all aspects of missile guidance systems, including sensors; terminal guidance technologies; control devices; data links for semiactive, beam rider, and command systems; data links for unmanned vehicle systems; missile fire control functions; and hardware and software systems for missile systems functions. It annually receives about \$42 million in federal R&D funds, approximately \$13.9 million of which are spent on in-house activities, and has about 186 civilian personnel, only a

portion of whom are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.

- The Software Engineering Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates are also located. This directorate conducts R&D on all aspects of computer hardware, software, and engineering for weapons systems requiring computer automation, with a particular emphasis on built-in test capabilities for computer systems. It annually receives about \$19.4 million in federal R&D funds, approximately \$4.5 million of which are spent on in-house activities, and has about 136 civilian personnel, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.
- The Propulsion and Structures Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates are also located. This directorate conducts R&D on all types of rocket propulsion technology, including propellants, ignition systems, gas operated power systems, propulsion systems controls, propulsion mechanics, structures, and materials. It annually receives about \$13.2 million in federal R&D funds, approximately \$7.7 million of which are spent on in-house activities, and has about 127 civilian personnel, only a portion of whom are directly involved in R&D ac-

tivities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.

- The Engineering Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates are also located. This directorate conducts R&D on new missile and weapon system concepts, hardware technology, critical process technology, software, and statistical methodology, with a particular focus on such areas as microelectronics and manufacturing and production technologies. It annually receives about \$24.6 million in federal R&D funds, approximately \$17.2 million of which are spent on in-house activities, and has about 665 civilian personnel, only a portion of whom are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.
- The Systems Simulation and Development Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates are also located. This directorate conducts R&D on aeroballistics, flight dynamics, aerodynamics, simulation theory and technology, math model verification and validation techniques, and real-time, time-critical simulation technology. It annually receives about \$29.7 million in federal R&D funds, approximately \$6.5 million of which are spent on in-house activities, and has about 100 civilian personnel, only a portion of whom are directly involved

in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.

- The Weapons Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates are also located. This directorate conducts R&D on missile, laser, microwave, and beam weaponry, with a particular focus on such matters as target signatures, electromagnetic propagation phenomena, electro- and magneto-optical interactions and materials, physics of the atmosphere, photochemical processes, optical computing, image processing, and high-energy lasers. It annually receives about \$8.6 million in federal R&D funds, approximately \$3.8 million of which are spent on in-house activities, and has about 59 civilian personnel, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.
- The Technical Management Directorate and the Applied Technology Initiative are units of DOD's Army Missile Research, Development, and Engineering Center. The center is headquartered in Huntsville at the Redstone Arsenal, where all its directorates and the initiative are also located. This directorate oversees the R&D activities of the center and annually receives approximately \$12 million of federal R&D funds, all of which are spent in in-house activities, and has about 315 civilian personnel, all of whom are directly involved in R&D activities. The initiative receives about \$51.7 million of federal R&D funds, ap-

proximately \$1.7 million of which is spent on in-house activities, and has about 16 civilian personnel. In October 1999, the Missile Research, Development, and Engineering Center was provisionally merged with the Aviation Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.

- The Redstone Technical Test Center is a unit of DOD. It is located at Redstone Arsenal and is the site of the Army's aviation and missile R&D test facilities. These facilities include wind tunnels, airworthiness units, and flight ranges. This federal facility annually receives approximately \$29 million of federal R&D funds, all of which are spent on in-house activities, and employs about 145 civilians, only a portion of whom are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Space and Missile Defense Technical Center is a unit of the Army inside DOD. The center conducts R&D on the missile technologies for the Ballistic Missile Defense Organization and on space and space-related technologies for the Army. Specific R&D activities of the center focus on such areas as high-energy lasers; directed energy weapons; structures; materials; weapons lethality, vulnerability, and survivability; optics, radar, and laser radar technology; high-performance microelectronics; sensor phenomenology; electromagnetic technologies; miniature interceptors; advanced computer hardware and software; and gallium nitride microwave power amplifiers. This federal unit annually receives about \$300 million in federal R&D funds, virtually all of which is spent on in-house activities, and has about 400 civilian personnel, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Space and Missile Defense Battle Laboratory is a unit of the Army inside DOD designed to provide warfighters with the

very latest space and missile defense capabilities. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. Its R&D activities focus on high-performance computing and simulations. The unit's Advanced Research Center is an R&D computational test-bed for missile defense programs, while its Simulation Center conducts R&D on future space and strategic defense applications. This federal unit annually receives about \$15 million of federal R&D funds, approximately \$4.5 million of which is spent on in-house activities, and has about 91 civilian personnel, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Mobile, Alabama, is home to DOD's Naval Research Laboratory *USS Shadwell* and the Department of Transportation's (DOT's) Fire and Safety Test Detachment.

- The *USS Shadwell* is a unit of DOD's Naval Research Laboratory. While the center of all of the laboratory's R&D activities is in the District of Columbia, it maintains a decommissioned ship as a floating laboratory in Mobile Bay. The focus of all activities on this ship, formerly the *USS Shadwell*, is developing, testing, and implementing techniques and equipment for use in shipboard firefighting. The funding and staffing for this ship are modest and are included in that for the main laboratory in the District of Columbia.
- The Fire and Safety Test Detachment is a unit of the Coast Guard Research and Development Center inside DOT's Coast Guard. It conducts research to improve marine fire protection and safety through the use of full-scale fire tests and evaluations. Specific R&D activities of this unit include investigating compartment burnouts, flammable liquids in drums, cargo and machinery space fires, container fire protection, hatch cover fire resistance, explosion suppression, deck foam systems, halon

alternatives, and smoke movement. The test site is on Little Sand Island in Mobile Bay and includes a tanker, a Victory ship, and a fire test area on the island. This federal R&D unit annually receives approximately \$305,000 in federal R&D funds and has one civilian employee.

Montgomery, Alabama, is home to DOI's Alabama District Office of Water Resources.

- The Alabama District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1 million in federal R&D funds.

Muscle Shoals, Alabama, is home to the Tennessee Valley Authority's Environmental Research Center.

- The Environmental Research Center (ERC) is the headquarters of the Tennessee Valley Authority's (TVA) Environmental Research and Services organization. ERC is responsible for cleansing the soil at Muscle Shoals contaminated by R&D conducted many years ago on fertilizer and munitions. To accomplish this, ERC has had to conduct R&D on how to clean up

soil contaminated with chemicals. Specifically, ERC develops enhanced bioremediation technologies for cleanup of PCBs and PAHs, researches biofilter technology to convert pollutant gases and liquids to harmless forms, studies the use of constructed wetlands and their value in removing heavy metals and organic pollutants from industrial and municipal wastes, provides economically feasible biomass conversion technologies for waste materials, and develops improved processes to convert wastes into useful products and environmental sensors for the detection and quantification of pollutants in various environments. In recent years, the resources devoted to environmental R&D by ERC have declined significantly because most of the cleaning up of Muscle Shoals is complete. Indeed, the cleanup of Muscle Shoals is scheduled to be finished in FY 2001. In FY 1998, only about \$5 million was spent on environmental R&D at ERC. By FY 2000, TVA expects this amount to fall to zero.

FEDERAL R&D GRANTS TO ALABAMA ENTITIES

Every major institution of higher education in Alabama is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, DOD, and NASA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Alabama, Auburn University, the University of South Alabama (USA), Tuskegee University, and Alabama A&M University. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, DOD, and NASA to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Alabama are ones from the Department of Justice (\$3 million), the Department of Education (\$2 million), and the Department of Transportation (\$2 million).

Table 1.1 – Sources of Federal R&D Grants to Higher Education in Alabama

	HHS		NSF		DOD		NASA		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Alabama	\$137M	559	\$6M	103	\$3M	19	\$5M	160	\$9M	43	\$159M	884
Auburn	\$2M	24	\$2M	39	\$2M	14	<\$1M	17	\$6M	247	\$12M	341
USA	\$10M	54	<\$1M	8	0	0	<\$1M	3	<\$1M	3	\$10M	68
Tuskegee	\$3M	5	0	0	\$1M	2	<\$1M	20	\$2M	27	\$6M	54
Alabama A&M	<\$1M	2	<\$1M	1	\$1M	7	\$1M	20	\$2M	38	\$4M	68
Other	\$1M	12	<\$1M	7	\$1M	2	<\$1M	8	<\$1M	2	\$2M	31
Total	\$152M	656	\$9M	158	\$7M	44	\$6M	228	\$18M	360	\$193M	1,446

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the School of Medicine at the University of Alabama at Birmingham.

Several other nonacademic institutions in Alabama also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Southern Research Institute in Birmingham (\$17 million), Blue Cross/Blue Shield in Birmingham (\$1 million), and Tensor Technology in Huntsville (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Alabama received 70 SBIR awards totaling \$19 million. Examples include a \$700,000 award from the Army to Quality Research, Inc., in Huntsville for work on a virtual reality battlefield management tool for command, control, and communications nets and a \$750,000 award from HHS to Bioelastics Research, Ltd., in Birmingham for work on injectable implants to correct urinary incontinence.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted via formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Alabama are ones valued at more than \$7.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Alabama every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN ALABAMA

Several entities in Alabama also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to Nichols Research Corporation, which in FY 1998 received close to \$133 million in DOD R&D contracts for its engineering, analysis, and design effort in support of national and theater missile defense programs; battle management/command, control, and communication systems; and sea-, air-, ground-, and space-based sensor systems. In addition, Teledyne Industries (\$76 million), Dynetics Inc. (\$62 million), Mevatec Corporation (\$41 million), Colsa Corporation (\$34 million), CAS Inc. (\$32 million), and the Boeing Company (\$31 million) received very large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. For example, Dynetics also received \$65,000 in R&D grants in FY 1998. The University of Alabama (\$42 million), Alabama A&M (\$1 million), and Auburn University (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$35 million of federal R&D dollars was also received in FY 1998 by entities in Alabama in the form of cooperative agreements. By far the largest of these cooperative agreements (\$19 million in FY 1998) came from DOE to Southern Co. Services Inc., in Birmingham for work on a hot gas cleanup test facility for coal gasification and pressurized combustion. Other federal agencies awarding cooperative agreements to Alabama-based entities include USDA, DOD, and NSF. Among these latter cooperative agreements is an award supporting one of NSF's Materials Research Science and Engineering Centers—the Center for Materials for Information Technology at the University of Alabama.

Chapter 2

Federal Research and Development in Alaska

- Approximately \$135 million of federal R&D funds are spent each year in Alaska.
- Alaska ranks 41st among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 4 percent of all federal funds spent in Alaska each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

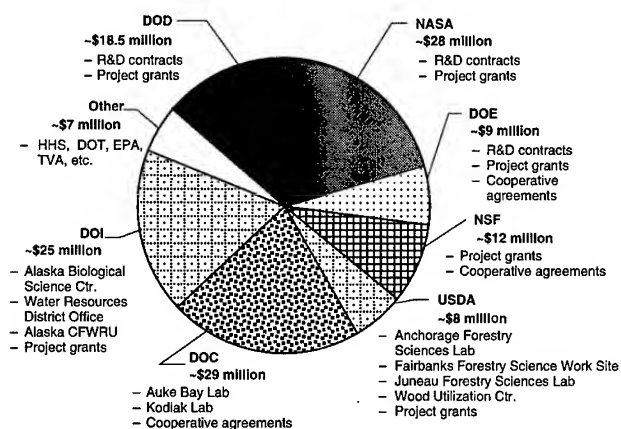


Figure 2.1 – Sources of Federal R&D Dollars Spent in Alaska
(Total Federal R&D ~\$135 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$135 million annually in Alaska on research and development (R&D) activities. On average, federal R&D dollars account for approximately 4 percent of all federal funds spent in Alaska each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Alaska. Foremost among these agencies are the Department of Commerce (DOC), the National Aeronautics and Space Administration (NASA), the Department of Interior (DOI), and the Department of Defense (DOD) which account for about 21, 20, 18, and 14 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF), the Department of Energy (DOE), and the Department of Agriculture (USDA) account for an additional 9, 6, and 6 percent, respectively. The remaining federal R&D dollars come collectively from the Department of Health and Human Services (HHS) and several other federal agencies.²

All federal R&D dollars spent in Alaska either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Alaska.

FEDERAL R&D UNITS IN ALASKA

Anchorage, Alaska, is home to USDA's Anchorage Forestry Sciences Laboratory, HHS's Arctic Investigations Program, and DOI's Alaska Biological Science Center and Alaska District Office of Water Resources.

- The Anchorage Forestry Sciences Laboratory is a unit of the Pacific Northwest Research Station inside USDA's Forest Service.

² For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

It conducts research on the moose, bear, and wolf populations of the region, the forestlands of Alaska, and the connection of tree pathogens to forest structure. Specific research activities of this laboratory include determining the relationship among competition, hunting, and predation to manage the wildlife populations for the greatest public good; improving forest inventory and monitoring techniques; and developing pheromone and silviculture for combating the spruce beetle. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about four employees.

- The Arctic Investigations Program is a unit of the National Center for Infectious Diseases inside HHS's Centers for Disease Control (CDC), headquartered in Atlanta, Georgia. It conducts research by performing disease surveillance, identifying risk factors for infectious diseases, implementing intervention strategies, and monitoring of prevention and control programs. Using epidemiology, laboratory, computer, and statistical sciences, the center investigates causes and dynamics of infectious diseases affecting arctic and subarctic populations in order to prevent and control the spread of them. Specific research activities of this unit include prevention and control of acute hepatitis B and *Haemophilus influenzae* type b (Hib), development of systems for monitoring antibiotic-resistant bacteria, and development of research programs on infectious agents that cause cancer. The program's disease prevention priorities are Hib; *Streptococcus pneumoniae* (pneumococcus); *Helicobacter pylori*; respiratory syncytial virus; and hepatitis A, B, and C. This federal unit annually receives approximately \$2 million of federal R&D funds and has about 23 FTEs.
- The Alaska Biological Science Center is a unit of DOI's U.S. Geological Survey (USGS). It conducts research throughout Alaska on a variety of fish and wildlife species and ecosystems. Field studies on fish and wildlife resources are central to the center's research, complemented by laboratory-based genetic analyses. Specific research activities of this center include studying the eco-

logical effects of petroleum development and pollution; investigating the effects of sport and subsistence harvests of arctic waterfowl, Dungeness crab, marine mammals, and terrestrial mammals; and studying the impact of hatchery enhancements on wild fish stocks. This federal R&D unit annually receives approximately \$5.6 million of federal R&D funds and has about 79 FTEs.

- The Alaska District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment Program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$2 million in federal R&D funds.

Fairbanks, Alaska, is home to USDA's Fairbanks Forestry Science Work Site and DOI's Alaska Cooperative Fish and Wildlife Research Unit.

- The Fairbanks Forestry Sciences Work Site is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. This unit is on the campus of the University of Alaska in Fairbanks. It conducts research to understand and manage the impact of climate, fire, and permafrost on the forest resources of the interior

of Alaska. Specific research activities of this work site include the Long-Term Ecological Research program, which investigates ecological processes operating at long time scales and over very broad spatial scales. This federal R&D unit annually receives approximately \$600,000 of federal R&D funds and has about two employees.

- The Alaska Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the Fairbanks campus of the University of Alaska. It conducts research on fisheries and aquatic ecology of freshwater in interior and arctic Alaska, as well as ecological studies of other Alaskan wildlife. Specific research activities of this unit include studying the impact of oil and related northern development on wildlife resources. This federal R&D unit annually receives approximately \$400,000 of federal R&D funds and has about four FTEs.

Juneau, Alaska, is home to USDA's Juneau Forestry Sciences Laboratory and DOC's Auke Bay Laboratory.

- The Juneau Forestry Sciences Laboratory is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. It conducts research on how to balance the conflicting needs of the logging, fishing, and sport hunting industries with the need to preserve the habitat of all forms of wildlife. Specific research activities of this laboratory include studies of the effects of landslides on aquatic habitats in streams, the role played by the presence of large wood and trees in streams, and the connection between riparian birds and mammals. This federal R&D unit annually receives approximately \$3.6 million of federal R&D funds and has about 39 employees.
- The Auke Bay Laboratory is a unit of the Alaska Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts research on stock identification, groundfish assessment, marine salmon interactions, ocean-carrying capacity, habitats, and the aftermath of the *Exxon Valdez* oilspill. Specific research activities focus on

U.S./Canada salmon issues, salmon net pen and aquaculture, and fish habitat studies throughout Alaska. This federal unit annually receives approximately \$8.5 million of federal R&D funds and has approximately 71 FTEs, only a portion of whom are involved in R&D activities.

Kodiak, Alaska, is home to DOC's Kodiak Laboratory.

- The Kodiak Laboratory is a unit of the Northwest Fisheries Science Center inside DOC's NOAA. The laboratory coordinates research activities with the center in conservation biology, environmental conservation, fishery resource analysis and monitoring, fish ecology, and resource enhancement and utilization techniques. It also conducts research on the populations and ecosystems of shellfish and groundfish. This federal unit annually receives approximately \$1.2 million of federal R&D funds and has about 12 FTEs, only a portion of whom are involved in R&D activities. It also annually receives an additional \$273,000 of federal R&D funds and another two FTEs from the Northwest Fisheries Science Center.

Sitka, Alaska, is home to USDA's Wood Utilization Center.

- The Wood Utilization Center is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. It conducts research to determine the scale of logging and forest product manufacturing that is consistent with the environmental and economic objectives of southeast Alaska. Specific research activities of this laboratory include identifying the type and scale of harvesting operations and manufacturing facilities consistent with timber resources, economic conditions, market opportunities, and economic development objectives of communities in southeast Alaska. This federal R&D unit is in the process of being developed, so information on its federal R&D funding and its staffing are not yet tracked separately.

FEDERAL R&D GRANTS TO ALASKA ENTITIES

Every major institution of higher education in Alaska is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by NSF, DOC, NASA, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Alaska. The table below shows the number of R&D grants active in FY 1998, highlighting those made by NSF, DOC, NASA, and USDA to parties at this institution and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category going to the University of Alaska are from HHS and DOD (close to \$1 million each).

Table 2.1 – Sources of Federal R&D Grants to Higher Education in Alaska

Institution	NSF		DOC		NASA		USDA		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Alaska	\$7M	100	\$4M	11	\$2M	33	\$2M	35	\$3M	23	\$17M	202
Other	<\$1M	1	0	0	0	0	0	0	<\$1M	2	<\$1M	3
Total	\$7M	101	\$4M	11	\$2M	33	\$2M	35	\$3M	25	\$17M	205

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Alaska also receive a significant amount of federal R&D grants each year. Foremost among these institutions in Alaska that received R&D grants in FY 1998 are Ketchikan Public Utilities in Ketchikan (\$10 million) and the Alaska Department of Community and Regional Affairs in Anchorage (\$2 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Alaska received three SBIR awards totaling \$263,000. Examples include a \$90,000 award from NSF to Imlach Consulting Engineering in Anchorage for work on a reliable low-cost support system for flywheel energy storage and a \$70,000 award from EPA to Hydro-Solutions and Purification in Fairbanks to develop a prototype for the effective removal of selenium in wastewater utilizing enhanced iron co-precipitation.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Alaska are ones valued at more than \$1.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Alaska every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN ALASKA

Several entities in Alaska also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of the funds go to the University of Alaska, which in FY 1998 received close to \$6 million in R&D contracts, primarily to operate and manage NASA's Alaska Synthetic Aperture Radar (SAR) Facility. In addition, the Prince William Sound Science Center (\$1 million) and ABR, Inc. (\$1 million), received significant R&D contracts from federal agencies in FY 1998.

A total of \$10 million of federal R&D dollars was also received in FY 1998 by entities located in Alaska in the form of cooperative agreements. The largest of these cooperative agreements (\$2 million in FY 1998) came from DOE to Kotzebue Electric Association in Kotzebue to test wind turbines in the Arctic environment. Another of these cooperative agreements (\$1.6 million in FY 1998) came from DOC to the University of Alaska to operate the Cooperative Institute for Arctic Research (CIFAR). Other federal agencies awarding cooperative agreements to Alaska-based entities include DOC and the Department of Interior.

Chapter 3

Federal Research and Development in Arizona

- Approximately \$862 million of federal R&D funds are spent each year in Arizona.
- Arizona ranks 20th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 8 percent of all federal funds spent in Arizona each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

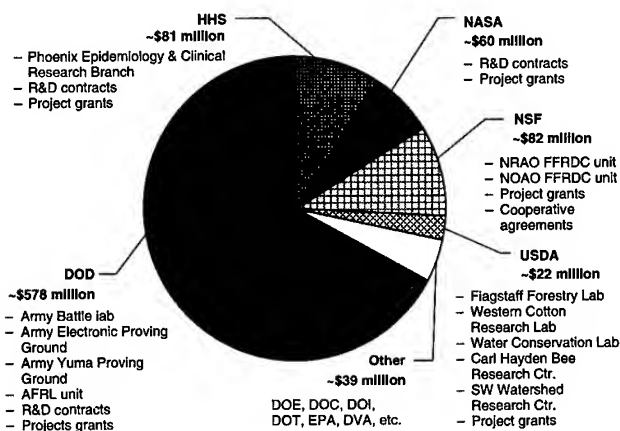


Figure 3.1 – Sources of Federal R&D Dollars Spent in Arizona
(Total Federal R&D ~\$862 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$862 million annually in Arizona on research and development (R&D) activities. On average, federal R&D dollars account for approximately 8 percent of all federal funds spent in Arizona each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Arizona. Foremost among these agencies is the Department of Defense (DOD), which accounts for 67 percent of all federal R&D dollars spent in the state. The National Science Foundation (NSF) and the Department of Health and Human Services (HHS) each account for an additional 9 percent, while the National Aeronautics and Space Administration (NASA) accounts for an additional 7 percent of federal R&D dollars spent in the state. The remaining federal R&D dollars come collectively from the Department of Agriculture (USDA) and several other agencies.³

All federal R&D dollars spent in Arizona either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Arizona.

FEDERAL R&D UNITS IN ARIZONA

Flagstaff, Arizona, is home to Department of Interior's (DOI's) Colorado Plateau Field Station and USDA's Forestry Sciences Laboratory.

- The Colorado Plateau Field Station is a unit the Forest and Rangeland Ecosystem Science Center inside DOI's U.S. Geological Survey (USGS). It conducts research in ecoregionalism and conservation planning. Specific research activities of this unit include studying endangered species, investigating the im-

³ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

pact of vegetation distribution on the ecosystem, and researching wildlife ecology. This federal R&D unit annually receives approximately \$606,000 in federal R&D funds and has about 10 FTEs.

- The Flagstaff Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. The laboratory, which is located on the campus of Northern Arizona University, conducts research on vegetation, watershed, and wildlife and fisheries resources. Specific research activities include examining the impact of forest insects and diseases on the ecosystem, determining the interface between the wildlands and urban areas of the Southwest, and investigating the buildup of hazardous fuels and the potential for fire to erupt in the Southwest. Other research activities focus on studying the factors that influence populations and habitats of threatened, endangered, and sensitive species in the southwestern forest; and researching the interrelationships among hydrologic, geomorphic, and biotic processes that affect fish habitat, riparian vegetation, channel dynamics, and instream flow regimes. This federal R&D unit annually receives approximately \$4.7 million of federal R&D funds and has about 42 employees.

Fort Huachuca, Arizona is home to DOD's Electronic Proving Ground and one of DOD's Battle Command Battle Laboratories.

- The Electronic Proving Ground is a unit of the Army's White Sands Missile Range in DOD. It supports developers by conducting tests and experiments of new electronic systems including command, control, communications, computer, intelligence, and electronic warfare equipment. Its projects have included the Enhanced Position Location Reporting System, the Single Channel Ground and Airborne Radio System, and the Mobile Subscriber Equipment. The funding and staffing information for this unit are included in those provided for the White Sands Missile Range in New Mexico.

- The Battle Command Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. This unit is one of three laboratories focusing specifically on battle command matters. The other two are located in Fort Leavenworth, Kansas, and Fort Gordon, Georgia. Together, the three Battle Command Battle Laboratories teach the art and science of battle command and information warfare to commanders to enable them to operate anywhere on the battlefield, as well as on the move. This particular laboratory conducts research on intelligence collection and dissemination and electronic warfare. Specific R&D activities of this laboratory include developing the net battle command vehicle, conducting experiments on the impact of information on decisionmakers and their staffs, developing a decision support system for battle commanders, and studying how best to focus intelligence information on the tactical decisionmaker. This federal unit annually receives about \$825,000 of federal R&D funds, only a portion of which is spent in-house, and has two civilian personnel.

Mesa, Arizona, is home to a unit of DOD's Air Force Research Laboratory Warfighter Training Research Division.

- The Human Effectiveness Directorate Warfighter Training Research Division is a unit of DOD's Air Force Research Laboratory. The directorate is headquartered in Dayton, Ohio, with an additional site in San Antonio, Texas. This division develops warfighter training techniques and technologies, conducts research into night vision device training, and develops head-tracking systems for aircraft simulators. This federal unit annually receives about \$13 million, only about 25 percent of which is spent on in-house activities, and employs about 37 civilians, only a portion of whom are involved in R&D activities.

Phoenix, Arizona, is home to HHS's Phoenix Epidemiology and Clinical Research Branch, USDA's Western Cotton Research Laboratory

and U.S. Water Conservation Laboratory, and a Department of Veterans Affairs (DVA) R&D unit.

- The Phoenix Epidemiology and Clinical Research Branch is a part of the National Institute of Diabetes and Digestive and Kidney Diseases inside HHS's National Institutes of Health (NIH) that is headquartered in Bethesda, Maryland. It conducts research on diabetes and its complications, obesity, and digestive and kidney diseases, all of which are disproportionately common among southwestern American Indians. Specifically, the branch studies diabetes mellitus and obesity, including the conduct of clinical investigations, among Pima Indians. This federal unit has an average annual budget of approximately \$4.7 million and has about 80 employees.
- The Western Cotton Research Laboratory is a unit of the USDA's Agricultural Research Service (ARS). It is composed of two research management divisions focusing on cotton insect pest management, biocontrol, and genetics; cotton physiology and genetics; and host plant resistance. One of these research divisions develops and improves ecological and genetic methods to reduce losses by cotton insects and mites. Research in this unit includes investigations of the mode of action and role of semiochemicals, genetic approaches, genetic engineering, and cultural practices in basic biology, ecology, and population dynamics of cotton insect pest and beneficial species. The second division conducts research on the physiological, genetic, and entomological aspects of short- and extra-long-staple cotton. This federal R&D unit, in combination with the U.S. Water Conservation Laboratory described below, annually receives approximately \$7.7 million of federal R&D funds and has about 109 FTEs.
- The U.S. Water Conservation Laboratory is a unit of the USDA's ARS. It is composed of two research divisions focusing on irrigation water quality and environmental and plant dynamics. The laboratory conducts research on the development of more

efficient irrigation systems, better management criteria for irrigation systems, and better methods for scheduling irrigations. Specific research activities of this laboratory include exploring the potential uses of remote sensing techniques and technology, investigating ways to protect groundwater from agricultural chemicals, and predicting the effect of future increases of atmospheric CO₂ on climate and on yields and water requirements of agricultural crops. The staffing and funding information for this federal R&D unit is included in those provided for the Western Cotton Research Laboratory described immediately above.

- While the principal focus of the Carl T. Hayden VA Medical Center in Phoenix is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 125 projects with total funding of less than \$100,000. These R&D activities focus on a wide range of topics, including endoscopy, diabetes, and gastrointestinal disorders.

Tucson, Arizona, is home to USDA's Carl Hayden Bee Research Center and Southwest Watershed Research Center, DOI's Arizona Cooperative Fish and Wildlife Research Unit and Arizona District Office of Water Resources, a portion of NSF's National Radio Astronomy Observatory and the headquarters of NSF's National Optical Astronomy Observatories, and a DVA R&D unit.

- The Carl Hayden Bee Research Center is a unit of the USDA's ARS located on the campus of the University of Arizona. It conducts research to improve crop pollination and honeybee colony productivity through quantitative ecological studies of honeybee behavior, physiology, pests and diseases, and feral honeybee bionomics. Specific research activities focus on improving honeybee pollination of fruit and seed crops and other ecologically important plant species, assessing the impact of mites and their associated microbes honeybee colonies, and developing new techniques for the detection and control of feral Africanized

honeybees. This federal R&D unit, in combination with the Southwest Watershed Research Center described immediately below, annually receives approximately \$3.5 million of federal R&D funds and has about 41 FTEs.

- The Southwest Watershed Research Center is a unit of the USDA's ARS located on the campus of the University of Arizona. It conducts research on hydrology and water resources, erosion and sedimentation, and water quality. Specific research activities seek to improve decision support systems and are conducted in conjunction with a global climate change project. Recent studies have focused on temporal, spatial, and intensity scales affecting erosion processes on rangelands. Other research has explored the interactions of long-term climatic, hydrologic, and vegetation records to evaluate potential climatic change impacts on semiarid rangeland water resources. The funding and staffing for this federal R&D unit are included in those for the Carl Hayden Bee Research Center described immediately above.
- The Arizona Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. This unit is on the campus of the University of Arizona. It conducts research on fishery ecology and management. Specific research activities of this unit include investigating habitat utilization of native fishes, looking into better management of game fishes, investigating nontraditional forms of aquaculture, and studying the effects of environmental contaminants on aquatic systems. This R&D unit annually receives approximately \$278,000 in federal R&D funds and has about three FTEs.
- The Arizona District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial

contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$2.4 million in federal R&D funds.

- The National Radio Astronomy Observatory (NRAO) is a federally funded research and development center (FFRDC) sponsored by the NSF and operated by Associated Universities, Inc. It is headquartered in Charlottesville, Virginia, with observing sites in Green Bank, West Virginia; Tucson, Arizona; and Socorro, New Mexico. NRAO was established to ensure that all qualified scientists have access to radio astronomy facilities. NRAO's 12-meter, millimeter-wavelength telescope is located atop Kitt Peak southwest of Tucson, Arizona, and is used to conduct continuum and spectral-line studies involving wavelengths between one millimeter and one centimeter long. Each year the four sites of this federally owned and consortium-operated unit collectively receive approximately \$44 million of federal R&D funds to conduct operations. The Tucson site annually receives approximately \$2 million of federal R&D funds and has about 30 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The National Optical Astronomy Observatories (NOAO) is an FFRDC sponsored by the NSF and operated by the Association of Universities for Research in Astronomy, Inc. Headquartered in Tucson, NOAO consists of an observatory on Kitt Peak, southwest of Tucson; an observatory north of Santiago, Chile,

on the western slopes of the Andes; and a solar observatory co-located on Kitt Peak and Sunspot, New Mexico. Together, NOAO's observatories constitute the national center for ground-based optical and infrared astronomy and solar physics. The collective parts of this federally owned and consortium-operated unit annually receive approximately \$35 million of federal R&D funds and have about 300 employees. NOAO is also the U.S. headquarters for the Gemini Observatories project, a partnership among the United States, the United Kingdom, Canada, Australia, Chile, Brazil, and Argentina. With NSF acting as the executive agent for this project, one eight-meter optical/infrared telescopes is in operation in Mauna Kea, Hawaii, and a second is under construction in Chile. Both telescopes are designed to operate on-site or remotely. The total U.S. contribution to this international R&D effort has annually totaled approximately \$35 million of federal R&D funds in recent years, only a small portion of which is spent in Arizona.

- While the principal focus of the Southern Arizona VA Healthcare System facility, the VA Medical Center in Tucson, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 277 projects with total funding of approximately \$1 million. These R&D activities focus on a wide range of topics, including congestive heart failure, prostatic neoplasms, and drug therapy.

Yuma, Arizona is home to DOD's Army Yuma Proving Ground.

- The Army Yuma Proving Ground is a unit of DOD. It focuses on the planning, execution, and reporting of development and production testing of artillery, direct fire, automotive, aviation systems, mines and countermines, unexploded ordnance systems, air delivery, and soldier equipment. Testing has included the M1A1 Abrams Tank and the Unmanned Aerial Vehicle Close Range, among others. This federal unit annually receives approximately \$115 million of federal R&D funds, about \$15

million of which are spent on in-house activities, and has about 666 civilian personnel.

FEDERAL R&D GRANTS TO ARIZONA ENTITIES

Every major institution of higher education in Arizona is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, NASA, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Arizona, Arizona State University (ASU), and Northern Arizona University (NAU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, NASA, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Arizona are ones from USDA (\$5 million), DOE (\$3 million), and the Environmental Protective Agency (EPA) (\$2 million). The comparable grants in this category going to Arizona State University include \$1 million from DOE and the remainder distributed primarily by USDA, EPA, and the Department of Justice.

Table 3.1 – Sources of Federal R&D Grants to Higher Education in Arizona

	HHS		NSF		NASA		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Arizona	\$65M	303	\$17M	367	\$13M	220	\$11M	51	\$11M	304	\$116M	1,245
ASU	\$9M	53	\$12M	191	\$1M	47	\$3M	26	\$3M	46	\$28M	363
NAU	\$2M	8	\$2M	36	<\$1M	10	0	0	\$1M	21	\$5M	75
Other	\$1M	3	<\$1M	1	<\$1M	2	0	0	<\$1M	5	\$1M	11
Total	\$76M	367	\$31M	595	\$15M	279	\$14M	77	\$16M	376	\$151M	1,694

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and un-

derstanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the College of Medicine at the University of Arizona.

Several other nonacademic institutions in Arizona also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Saint Joseph's Hospital and Medical Center in Phoenix (\$3 million), Materials and Electrochemical Research Corp. in Tucson (\$2 million), Lowell Observatory in Flagstaff (\$1 million), the Primate Foundation of Arizona in Mesa (\$1 million), and the Sun Health Research Institute in Sun City (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Arizona received 84 SBIR awards totaling \$19 million. Examples include a \$700,000 award from DOT to Catalina Engineering, Inc., in Tucson to develop highway capacity software using a portable graphical user interface format and a \$600,000 award from the Navy to FATS, Inc., in Phoenix for work on a virtual vertical aircraft signal trainer.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Arizona are ones valued at more than \$2 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Arizona every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN ARIZONA

Several entities in Arizona also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go from DOD to the Raytheon Company (including its newly acquired Hughes subsidiaries), which in FY 1998 received close to \$296 million in R&D contracts for such efforts as the development of the AIM-9X Sidewinder Missile System and the Block Six Advanced Medium-Range Air-to-Air Missile (AMRAAM) program. In addition, Lockheed Martin (\$99 million), Orbital Sciences Corp. (\$37 million), Motorola, Inc. (\$25 million), Interop Joint Venture (\$18 million), and AlliedSignal, Inc. (\$16 million), also received very large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. The University of Arizona (\$13 million) and ASU (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$10 million of federal R&D dollars was also received in FY 1998 by entities located in Arizona in the form of cooperative agreements. The largest of these cooperative R&D agreements (\$2.3 million in FY 1998) came from NSF to Arizona State University in Tempe, in support of the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT). Other federal agencies awarding cooperative agreements to Arizona-based entities include DOE, the Department of Interior, and NSF. Among these latter cooperative agreements is an award supporting one of NSF's Materials Research Science and Engineering Centers at Arizona State University. Not included among these cooperative agreements are the two that were awarded by NSF to the Association of Universities for Research in Astronomy (AURA) for the operation of the National Optical Astronomy Observatories, a federally funded research and development center. This FFRDC is detailed in the section on "Federal R&D Units in Arizona."

Chapter 4

Federal Research and Development in Arkansas

- Approximately \$120 million of federal R&D funds are spent each year in Arkansas.
- Arkansas ranks 42nd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 3 percent of all federal funds spent in Arkansas each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

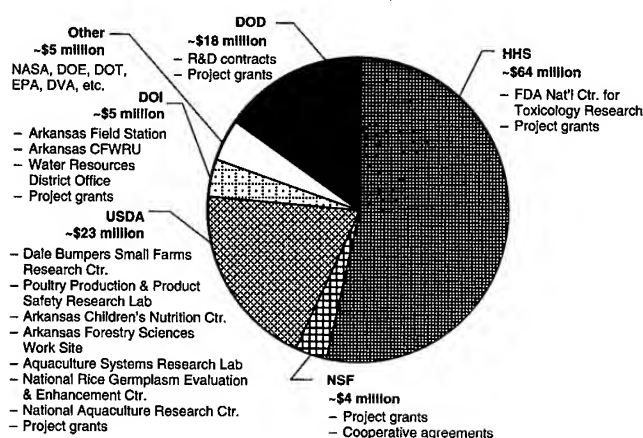


Figure 4.1 – Sources of Federal R&D Dollars Spent in Arkansas
(Total Federal R&D ~\$120 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$120 million annually in Arkansas on research and development (R&D) activities. On average, federal R&D dollars account for approximately 3 percent of all federal funds spent in Arkansas each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Arkansas. Foremost among these agencies is the Department of Health and Human Services (HHS), which accounts for 53 percent of all federal R&D dollars spent in the state. The Department of Agriculture (USDA) and the Department of Defense (DOD) account for an additional 19 and 15 percent of the federal R&D dollars in Arkansas, respectively. The remaining federal R&D dollars come collectively from the Department of Interior (DOI), the National Science Foundation (NSF), and several other federal agencies.⁴

All federal R&D dollars spent in Arkansas either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Arkansas.

FEDERAL R&D UNITS IN ARKANSAS

Booneville, Arkansas, is home to USDA's Dale Bumpers Small Farms Research Center.

- The Dale Bumpers Small Farms Research Center is a unit of USDA's Agricultural Research Service (ARS). It examines the scientific basis for efficiently managing small-farm ecosystems and develops innovative and appropriate technologies to enhance the efficiency, sustainability, and productivity of small

⁴ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

farms. Specific research activities include identifying viable alternative crops for small farms, improving the productivity of ruminants, and minimizing erosion and runoff losses. The research activities of the unit contribute to ARS's national programs on soil resource management, grazingland management, animal production systems, and integrated farming systems. This federal R&D unit annually receives approximately \$2.1 million and has about 20 FTEs.

Fayetteville, Arkansas is home to DOI's Arkansas Field Station and Arkansas Cooperative Fish and Wildlife Research Units and USDA's Poultry Production and Product Safety Research Laboratory.

- The Arkansas Field Station is a unit of the Northern Prairie Wildlife Research Center inside DOI's U.S. Geological Survey (USGS). This unit is located on the campus of the University of Arkansas. It conducts research on grassland ecology in the south-central Great Plains region. Specific research activities of this unit focus on the development of a long-term monitoring program for grassland birds of the Great Plains National Parks. This federal R&D unit annually receives approximately \$72,000 of federal R&D funds and has one FTE.
- The Arkansas Cooperative Fish and Wildlife Research Unit is unit of DOI's USGS. The unit is located on the campus of the University of Arkansas. It conducts research on fish and wildlife ecology. Specific research activities of this unit include studying the effects of forest management on scrub-successional and forest-interior birds, population parameter estimation, avian reproductive ecology, habitat selection of birds, waterfowl life history dynamics, American woodcock, wood thrush, Bachman's sparrow, and webless game birds. The unit also provides scientific training in fisheries and wildlife management techniques to students at the graduate level. This federal R&D unit annually receives approximately \$165,000 of federal R&D funds and has about two FTEs.
- The Poultry and Food Science Research Laboratory is a unit of USDA's ARS. The lab is located on the campus of the University

of Arkansas. It conducts research on poultry production and product safety. Specific research activities of this laboratory include studying avian bone development and maturation, a metabolic disease in chickens known as ascites, and a disease in turkeys known as turkey osteomyelitis. Other research activities focus on a disease activity known as proventriculitis, increasing the intestinal strength of poultry, and determining the effect the use of poultry waste as fertilizer has on surface and groundwater. This federal R&D unit annually receives approximately \$1.3 million of federal R&D funds and has about 12 FTEs.

Jefferson, Arkansas, is home to HHS's National Center for Toxicological Research and the Arkansas Regional Laboratory.

- The National Center for Toxicological Research (NCTR) is a unit of HHS's Food and Drug Administration (FDA). It conducts research to support and anticipate the FDA's regulatory needs. Specifically, the center conducts research designed to define the biological mechanisms underlying the toxicity of products regulated by the FDA. This research is designed to understand the critical biological events involved in the expression of toxicity and to develop methods to improve assessment of human exposure, susceptibility, and risk. Co-located with this unit is the FDA's Arkansas Regional Laboratory, which also conducts some R&D on matters of general concern to the FDA. Together these federal units annually receive approximately \$32.2 million of federal R&D funds and have about 218 FTEs directly involved in R&D activities.

Little Rock, Arkansas, is home to USDA's Arkansas Children's Nutrition Center, DOI's Arkansas District Office of Water Resources, and a Department of Veterans Affairs (DVA) R&D unit.

- The Arkansas Children's Nutrition Center is a unit of USDA's ARS. It conducts research on the diet of children from birth to adolescence to optimize their nutrition and health, both as children and later as adults. Controlled human studies are conducted with a focus on metabolic, endocrinologic, and im-

munologic factors to determine the role of diet in human health and development. Specific research activities of this center examine such matters as the connection between nutrition/diet and brain function and the effect of specific nutrients on body functions. This federal R&D unit annually receives approximately \$5.7 million of federal R&D funds and has about two FTEs.

- The Arkansas District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$853,000 in federal R&D funds.
- While the principal focus of the John L. McLellan Memorial Hospital, the VA Medical Center in Little Rock, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 277 projects with total funding of approximately \$3.5 million. These R&D activities focus on a wide range of topics, including diabetes, schizophrenia, and aging.

Monticello, Arkansas is home to USDA's Arkansas Forestry Sciences Work Site.

- The Arkansas Forestry Sciences Work Site, a unit of the Southern Research Station within USDA's Forest Service, is located on the campus of the University of Arkansas at Monticello. While the unit is headquartered in Monticello, research is also conducted at Crossett, Hot Springs, Jessieville, Jasper, and Fayetteville. Specific research activities of this unit include developing a better understanding of the environmental factors and ecological processes influencing the establishment and growth of forest reproduction to develop silvicultural alternatives for upland forests in the Midsouth as well as studying the effects of silvicultural treatments on forest stands and interactions between stands, which is needed to make landscape-level decisions. This federal R&D unit annually receives approximately \$1.2 million of federal R&D funds and has about 15 employees.

Pine Bluff, Arkansas is home to USDA's Aquaculture Systems Research Laboratory.

- The Aquaculture Systems Research Laboratory is a unit of the USDA's ARS. The laboratory is on the campus of the University of Arkansas at Pine Bluff and conducts research on the components of aquaculture production systems to improve the efficiency of freshwater fish farming, including cultural and processing methods to enhance and sustain product quality. Specific research activities of this unit focus on such matters as assessing various scenarios to optimize profit potential from the production of channel catfish, improving and developing postharvest procedures to enhance the marketability of farm-raised fish, and conducting engineering-related studies to improve the general efficiency and profitability of fish farming. This federal R&D unit annually receives approximately \$495,000 of federal R&D funds and has about three FTEs.

Stuttgart, Arkansas, is home to USDA's National Rice Germplasm Evaluation and Enhancement Center and National Aquaculture Research Center.

- The National Rice Germplasm Evaluation and Enhancement Center, also known as the Dale Bumpers National Rice Re-

search Center, is a unit of USDA's ARS located on the campus of the University of Arkansas. It conducts research to help the U.S. rice industry stay competitive in the global marketplace by assuring high crop yields, superior grain quality, pest resistance, and stress tolerance. Specific research activities focus on such areas as utilizing molecular genetics and molecular biology, grain chemistry, and plant physiology to better evaluate and enhance the quality of rice germplasm maintained and distributed by the center. This federal R&D unit, in combination with the National Aquaculture Research Center described immediately below, annually receives approximately \$2.9 million of federal R&D funds and has about 26 FTEs.

- The National Aquaculture Research Center is a unit of USDA's ARS located on the campus of the University of Arkansas. It conducts research to develop methods for commercially producing fish on flooded fields in rotation with rice crops. The center's primary interest is on warmwater aquaculture species, such as hybrid striped bass, tilapia, carp, eels, ornamental species, and baitfish. Specific research activities of this center focus on such areas as the use of chemicals in aquaculture, the effect of diet on fish flavor, the connection between fish disease and water quality, and the rearing of zooplankton. The staffing and funding for this federal R&D unit is included in those presented for the Dale Bumpers National Rice Research Center described immediately above.

FEDERAL R&D GRANTS TO ARKANSAS ENTITIES

Every major institution of higher education in Arkansas is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, USDA, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Arkansas system. The table below shows the number of R&D grants

active in FY 1998, highlighting those made by HHS, USDA, NSF, and DOD to parties at this institution and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Most of the grants in the “Other Agencies” category going to the University of Arkansas came from the Department of Education, NASA, and the Department of Transportation.

Table 4.1 – Sources of Federal R&D Grants to Higher Education in Arkansas

	HHS		USDA		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Arkansas	\$22M	125	\$8M	285	\$4M	57	\$3M	11	\$2M	31	\$39M	509
Other	<\$1M	1	<\$1M	2	0	3	0	0	<\$1M	4	<\$1M	10
Total	\$22M	126	\$8M	287	\$4M	60	\$3M	11	\$3M	35	\$39M	519

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Arkansas also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Arkansas Blue Cross & Blue Shield in Little Rock (\$2 million), Arkansas Children’s Hospital in Little Rock (\$2 million), the Arkansas State Department of Health in Little Rock (\$1 million), and Biotechnical Services, Inc., in North Little Rock (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Arkansas received three SBIR awards totaling \$1 million. Examples include a \$750,000 award from DOE to Hot Metal Molding,

Inc., in Arkadelphia for work on using thermal transformation technology to produce semisolid formable alloys and a \$75,000 award from NSF to Parallel Quantum Solutions in Fayetteville to develop personal computer-based integrated software and hardware for quantum chemistry modeling.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Arkansas are ones valued at more than \$5 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Arkansas every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN ARKANSAS

Several entities in Arkansas also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to BEI Sensors & Systems Company in North Little Rock, which in FY 1998 received close to \$1 million from NASA for an R&D contract to design, develop, and fabricate the scanner unit for the Space-Readiness Coherent Lidar Experiment (SPARCLE).

A total of \$2 million of federal R&D dollars was also received in FY 1998 by entities located in Arkansas in the form of cooperative agreements. The largest of these cooperative agreements (\$1 million in FY 1998) came from NSF to the University of Arkansas to fund EPSCoR (Experimental Program to Stimulate Competitive Research) activities. Other federal agencies awarding cooperative agreements to Arkansas-based entities include USDA and the Department of Interior.

Chapter 5

Federal Research and Development in California

- Approximately \$14.4 billion of federal R&D funds are spent each year in California.
- California ranks 1st among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 19 percent of all federal funds spent in California each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

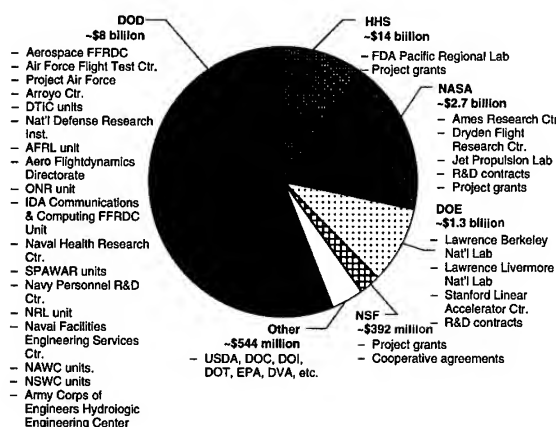


Figure 5.1 – Sources of Federal R&D Dollars Spent in California
(Total Federal R&D ~\$14.4 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$14.4 billion annually in California on research and development (R&D) activities. On average, federal R&D dollars account for approximately 19 percent of all federal funds spent in California each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in California. Foremost among these agencies is the Department of Defense (DOD), which accounts for 56 percent of all federal R&D dollars spent in the state. The National Aeronautics and Space Administration (NASA) accounts for an additional 19 percent of the federal R&D dollars spent in California, while the Department of Health and Human Services (HHS), the Department of Energy (DOE), and the National Science Foundation (NSF) account for 10, 9, and 3 percent, respectively. The remaining federal R&D dollars come collectively from the Departments of Commerce (DOC), Agriculture (USDA), Transportation (DOT), Veterans Affairs (DVA), and Interior (DOI) and from several other federal agencies.⁵

All federal R&D dollars spent in California either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in California.

FEDERAL R&D UNITS IN CALIFORNIA

Albany, California, is home to USDA's Western Regional Research Center, Plant Genome Expression Center, and Pacific Southwest Research Station.

⁵ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

- The Western Regional Research Center is a unit of USDA's Agricultural Research Service (ARS). It consists of five research divisions focusing on cereal product utilization, crop improvement and utilization, plant protection, food safety and health, and process chemistry and engineering. Specific research activities include the use of image analysis to detect the structure of food; developing biotechnological approaches to improve postharvest properties; and researching the adhesion of pathogens to surfaces of poultry, fruits, and vegetables. This federal R&D unit, in combination with the Plant Genome Expression Center described immediately below, annually receives approximately \$22 million of federal R&D funds and has about 208 FTEs.
- The Plant Gene Expression Center is a unit of USDA's ARS that conducts research on high-throughput sequencing of plant genomic DNA to identify genes of rice, corn, soybeans, and other plants. Its research is conducted in collaboration with Stanford University and the University of Pennsylvania. The funding and staffing figures for this laboratory are included in those for the Western Regional Research Center described immediately above.
- The Pacific Southwest Research Station, headquartered in Albany, is a unit of USDA's Forest Service. It conducts research on conifer genomics, variation, and evolutionary relationships and genetic conservation disease resistance. Specific activities of this research station include the development of integrated resource assessments and mitigation measures for changes in ecosystem structure, function, distribution, and long-term productivity, and investigation of the ecological roles and impacts of insects in Western forests. This federal R&D unit annually receives approximately \$4 million of federal R&D funds and has about 72 employees.

Arcata, California, is home to DOI's California Cooperative Fishery Unit and USDA's Redwood Sciences Laboratory.

- The California Cooperative Fishery Unit is part of DOI's U.S. Geological Survey (USGS). It is on the campus of Humboldt State University. It conducts research on California fish and aquatic resource problems, as well as ecosystem functions, to determine life history attributes of threatened and endangered species. Specific research activities of this unit include studying habitats supporting coastal salmonids, including streams, estuarine, and near-shore marine habitats. This federal R&D annually receives approximately \$90,000 of federal R&D funds and has one FTE.
- The Redwood Sciences Laboratory is a unit of the Pacific Southwest Research Station inside USDA's Forest Service. This laboratory, which is on the campus of Humboldt State University, conducts research on timber management, wildlife interactions, and management effects on hillslope processes, fisheries, and stream environment. Specific research activities of this laboratory include studies on forest management interactions for a variety of wildlife species in the Pacific Northwest, including the northern and California spotted owls, marbled murrelets, pine marten, Pacific fisher, and Pacific salmon. This federal R&D unit annually receives approximately \$2.3 million of federal R&D funds and has about 56 employees.

Berkeley, California, is home to DOE's Lawrence Berkeley National Laboratory.

- The Lawrence Berkeley National Laboratory is a federally funded research and development center (FFRDC) sponsored by the DOE and operated by the University of California at Berkeley. Its research focuses on advanced materials development, chemical reaction dynamics, building energy efficiency, electromechanical energy storage, heavy-ion fusion accelerator development, environmental science, Earth science, and the human genome. It also has a Low-Background Facility located in the powerhouse of the Oroville dam, a California Department of Water Resources facility. This site is specially configured for low-background gamma-ray spectroscopy and is used for sen-

sitive neutron counting. This federally owned and contractor-operated R&D laboratory annually receives approximately \$266 million of core funding, virtually all of which is spent on specific R&D projects, and has about 3,800 employees. A portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

Camarillo, California, is home to DOI's Pacific Outer Continental Shelf Regional Office.

- The Pacific Outer Continental Shelf Regional Office is a unit of DOI's Minerals Management Service (MMS). It conducts environmental studies on the effects of offshore mineral development from the California-Mexico border to the Washington-Canada border, focusing primarily on southern California. Specific research areas include physical oceanography, marine mammals, seabirds, and ecosystems. This federal unit annually receives approximately \$3 million of federal R&D funds and has about 100 employees, only eight of whom are directly involved in R&D activities.

China Lake, California, is home to a unit of DOD's Naval Air Warfare Center Weapons Division.

- The Naval Air Warfare Center Weapons Division is a unit of DOD. It is headquartered at the Naval Weapons Center in China Lake, with additional sites at the Pacific Missile Test Center at Point Mugu, California, and the Naval Ordnance Missile Test Station at White Sands Missile Range in New Mexico. The China Lake portion of the center develops weapons by conducting basic and applied research on hardware fabrication prototyping. Major weapons programs at China Lake include the Sidewinder, Sparrow, and Phoenix air-to-air missiles programs. The three parts of the center annually receive a total of approximately \$545 million of R&D funds, about \$363 million of which are spent in-house. China Lake has a staff of approximately 3,100 civilians, only a portion of whom are directly involved in R&D activities.

Corona, California, is home to DOD's Naval Surface Warfare Center Corona Division.

- The Naval Surface Warfare Center Corona Division, also known as the Naval Warfare Assessment Station at Corona, is a unit of DOD. The command conducts R&D on emerging Navy and joint warfare systems. The station focuses on making independent assessments of major weapons and combat systems for the Navy. The specific R&D activities of this unit focus on conducting capability assessments of surface warfare systems, including air defense, strike weapons, and theater ballistic missile defense. This unit also conducts R&D on test instrumentation, data collection, data distribution, and data archive technology to support test assessments. This federal unit annually receives approximately \$9.8 million of federal R&D funds for in-house activities and has about 723 civilian personnel, only a small portion of whom are actively involved in R&D activities.

Davis, California, is home to DOD's Hydrologic Engineering Center and USDA's ARS Research Facility at the University of California at Davis, Western Human Nutrition Research Center, Institute of Forest Genetics, and Western Center for Urban Forest Research and Education.

- The Hydrologic Engineering Center is a unit of the Water Resources Support Center within DOD's U.S. Army Corps of Engineers. It is headquartered in Alexandria, Virginia. The center conducts research, as well as providing training, planning analysis, and technical assistance, on hydrologic engineering for the Corps. Recent R&D activities include analyzing warehouse data to assess the water balance in the Coralville Reservoir and developing methods and models for urban hydrology. This federal unit annually receives approximately \$1.2 million of federal R&D funds and has about 35 employees.
- The ARS Research Facility at the University of California at Davis is a unit of USDA's ARS. The facility includes divisions focusing on exotic and invasive weed, crops pathology and ge-

netics, and clonal germplasm. One division conducts research on the impacts of tamarisk, or saltcedar, on biodiversity in the New World, biological control of yellow-star thistle, and the behavior and effects of other weed species. Another division conducts research on germplasm characterization, molecular marker maps, seedling vigor, submergence tolerance, and stem rot resistance. Yet another division receives, collects, preserves, evaluates, and distributes the germplasm of fruit and nut crops. This federal R&D unit annually receives approximately \$1.9 million of federal R&D funds and has about 25 FTEs.

- The Western Human Nutrition Research Center is a unit of USDA's ARS. It conducts research into the functional consequences of chronic energy restriction caused by undereating, micronutrient bioavailability, and imbalances stemming from poor food behaviors and/or excessive use of supplements or fortified foods. Specific research activities of this center in the next few years will focus on chronic energy restriction, nutrition, and health in women and the impact of protective factors in foods on physiological function and maintenance of health. This federal R&D unit annually receives approximately \$4.9 million of federal R&D funds and has about 34 FTEs.
- The Institute of Forest Genetics is a unit of the Pacific Southwest Research Station inside USDA's Forest Service. The institute is on the campus of the University of California at Davis and conducts research on genetic diversity, conservation genetics, biotechnology, and disease resistance. Specific research activities include identifying the extent and function of diversity in conifer species, documenting the origin of invasive plant species to aid in their control, discovering the role that genes play in controlling important traits in forest trees, and identifying specific genes in conifers that provide resistant to various virulent pathogens. This federal R&D unit annually receives approximately \$2.1 million of federal R&D funds and has about 30 employees.

- The Western Center for Urban Forest Research and Education is a unit of the Pacific Southwest Research Station inside USDA's Forest Service. This center, which is on the campus of University of California at Davis, conducts research that describes the structure of urban forests and related benefits and costs. Specific research activities include studies of the benefits of tree shade on parking lot microclimate and air quality, strategies for reducing sidewalk-repair costs due to conflicts with roots of street trees, effects of urban forests on stormwater runoff, and application of remote sensing technologies on volunteer-based tree inventory to monitor urban forest health. This federal R&D unit annually receives approximately \$389,000 of federal R&D funds and has about nine employees.

El Segundo, California, is home to DOD's Aerospace FFRDC and a regional office of the Defense Technical Information Center.

- The Aerospace FFRDC is sponsored by the Air Force and operated by the Aerospace Corporation. Its research focuses on the architecture and engineering of space and launch systems that have national security functions. A particular emphasis of Aerospace FFRDC's R&D activities is launch vehicle, satellite, and control systems hardware and software. This federally owned and contractor-operated R&D facility annually receives an average of about \$292 million of core funding and has a staff of approximately 2,600 employees in El Segundo. It has an additional 3,100 employees at other sites in the United States and abroad. A substantial portion of its funds are spent on the maintenance and operation of R&D equipment and facilities.
- The Western Regional Office of the Defense Technical Information Center (DTIC) contributes to R&D efforts by providing access to and facilitating the exchange of scientific and technical information. Specifically, DTIC concentrates on providing information on planned, ongoing, and completed DOD-related R&D to federal agencies and their contractors. This federal unit annually receives approximately \$240,000 of federal R&D funds and employs about three people.

Fresno, California, is home to USDA's Water Management Research Laboratory, Horticultural Crops Research Laboratory, and Fresno Forestry Sciences Laboratory.

- The Water Management Research Laboratory is a unit of USDA's ARS. It conducts research on irrigation and drainage water management practices, with the objective of developing practices and methods that use water efficiently, improve agricultural productivity and sustainability, and reduce negative environmental impacts of irrigated agriculture in semiarid and arid areas. Specific research activities include crop management for the preservation of soil and groundwater quality, irrigation management, and crop rotation as alternatives to methyl bromide. This federal R&D unit, in combination with the Horticultural Crops Research Laboratory described below, annually receives approximately \$7 million of federal R&D funds and has about 79 employees.
- The Horticultural Crops Research Laboratory is also a unit of USDA's ARS. It conducts research on fresh and dried crops, with a particular research focus on postharvest issues, such as methyl bromide alternatives. It consists of three research divisions focusing on crop protection and quarantine insects, the postharvest quality and genetics, and crop pathology and genetics management. One division conducts research on dried fruit and nut entomology, insect detection, and physiology and microbial control of stored products. The research areas of a second division include grape and stonefruit breeding and postharvest decay. The research focus of the third division includes the development of efficient control strategies for citrus viruses through biological, molecular, and recombinant DNA technology. The funding and staffing figures for this federal R&D unit are included with those presented immediately above for the Water Management Research Laboratory.
- The Fresno Forestry Sciences Laboratory is a unit of the Pacific Southwest Research Station inside USDA's Forest Service. It

conducts research on ecosystems in the Sierra Nevada Mountains. Specific research activities of this laboratory include studies to identify and describe linkages between various biological, physical, and human components of forest ecosystems and to evaluate forest management strategies aimed at sustaining plant, animal, and fish communities in the Sierra Nevada. Species of particular concern include the California spotted owl, pine martens, fishers, yellow-legged frogs, and other amphibians associated with riparian, meadow, and high-mountain lake habitats. This federal R&D unit annually receives approximately \$2.3 million of federal R&D funds and has about 17 employees.

La Jolla, California, is home to a unit of DOD's Institute for Defense Analyses Communications and Computing FFRDC and DOC's La Jolla Laboratory.

- The Center for Communications Research is one of three units constituting the Institute for Defense Analyses Communications and Computing FFRDC. This FFRDC, which is nominally headquartered in Alexandria, Virginia, is sponsored by the National Security Agency and operated by the Institute for Defense Analyses (IDA). The Center for Communications Research in La Jolla works closely with its sister unit in Princeton, New Jersey, to conduct mathematical research to support cryptography and cryptanalysis. These two units also conduct R&D on speech and special signals-processing techniques. Together with the Center for Computing Sciences in Bowie, Maryland, the three units of this federally owned and contractor-operated R&D center annually receive approximately \$35 million of core funding, all of which is federal R&D funds, and have about 150 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The La Jolla Laboratory is the headquarters unit of the Southwest Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). The laboratory's

Coastal Fisheries Division conducts research on the biomass of fish and the biological and environmental factors that affect their survival. Its Marine Mammal Division monitors the status of dolphin populations in the eastern tropical Pacific and the coastal marine mammals of California. This division also develops and tests mathematical models to determine how such factors as growth, reproduction, and geographic distribution of marine mammal populations influence population levels. The laboratory's Pelagic Fisheries Resources Division conducts basic fishery analysis and provides management information on tropical and temperate tunas, billfishes, and other large pelagic fishes. Its U.S. Antarctic Marine Living Resources Division gathers biological information to prevent overexploitation of fish and krill and to protect seal, penguin, and pelagic seabird populations off the northernmost tip of the Antarctic Peninsula and South Georgia Island. This federal unit annually receives approximately \$10.3 million of federal R&D funds and has about 97 FTEs, only a portion of whom are involved in R&D activities.

Lancaster, California, is home to NASA's Dryden Flight Research Center and a portion of DOD's Air Force Research Laboratory Propulsion Directorate and its Air Force Flight Test Center.

- The Dryden Flight Research Center is a unit of NASA. It is located at Edwards Air Force Base. The center conducts experimental flight research on integrated flight and propulsion controls; advanced optical sensors and controls; viscous drag reduction; advanced configurations; high-altitude, long-endurance aircraft; remotely piloted vehicle technology; hypersonic vehicles; high-speed civil transportation; advanced rockets; air-breathing propulsion concepts; instrumentation systems; and flight load predictions. This federal facility annually receives a total of approximately \$207 million, at least \$140 million of which directly involves R&D efforts. The center has about 558 FTEs, only a portion of whom are involved in R&D activities. A substantial portion of its funds is spent on the mainte-

nance and operation of R&D equipment and facilities. In a recent year, over \$20 million of R&D contracts were awarded by the center, approximately \$4 million of which were made to entities based in California.

- The Propulsion Directorate at Edwards Air Force Base is a unit of DOD's Air Force Research Laboratory. It is headquartered in Dayton, Ohio, and conducts research on rocket propulsion. Specific R&D projects focus on the high-energy density of matter and space-based interceptors for missile defense. This federal unit annually receives approximately \$49 million of federal R&D funds, only about 22 percent of which is spent on in-house R&D activities, and has about 219 civilian personnel, only a portion of whom are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Air Force Flight Test Center at Edwards Air Force Base conducts R&D on manned and unmanned aerospace systems. Specific activities of this center include research, development, test, and evaluation on testing aerospace systems and subsystems, including development testing of aerodynamic decelerators; weapons systems; electronic warfare systems; recovery of research vehicles; operating the USAF Test Pilot School; and developing, operating, and managing the Edwards Flight Test Range. This federal unit annually receives about \$551 million of federal R&D funds, approximately \$266 million of which are spent on in-house activities, and has almost 7,000 personnel, over 3,000 of whom are civilians.

Livermore, California, is home to DOE's Lawrence Livermore National Laboratory.

- The Lawrence Livermore National Laboratory is an FFRDC sponsored by DOE and operated by the University of California. It conducts research in a wide range of areas, including advanced defense technologies, energy, environment, and biosciences, as well as the basic sciences. Its R&D projects include high-energy-density plasmas in connection with space physics

and astrophysics, uranium as an energy resource, the use of cleaner energies as alternative fuels, and microtechnology. This federally owned and contractor-operated laboratory annually receives approximately \$1 billion of core funding and conducts an estimated \$627 million of specific R&D projects. The laboratory has about 9,000 employees. A portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities. An additional 890 people who work for Sandia National Laboratory in Albuquerque, New Mexico, are also located at this site.

Los Angeles, California, is home to HHS's Pacific Regional Laboratory Southwest and a DVA R&D unit.

- The Pacific Regional Laboratory—Southwest is a unit of HHS's Food and Drug Administration. It conducts research on food and cosmetic safety. Specific areas of research activity focus on food and drug chemistry, pesticides, and microbiology. Coupled with this unit is the FDA's San Francisco District Laboratory in Alameda, California, which also conducts a small amount of R&D. Together these federal units annually receive approximately \$325,000 in federal R&D funds and have about four FTEs directly involved in R&D activities.
- While the principal focus of the VA Greater Los Angeles Healthcare System facility, the VA Medical Center in West Los Angeles, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 1,065 projects with total funding of approximately \$6 million. These R&D activities focus on a wide range of topics, including drug therapy, schizophrenia, epilepsy, investigational drugs, functional colonic diseases, Alzheimer's disease, neoplasms, and congestive heart failure.

Menlo Park, California, is home to DOI's Geologic Western Regional Office and its co-located Western Regional Coastal and Marine Geology Center, and Western Mapping Center.

- The Geologic Western Regional Office is a unit inside DOI's USGS. It oversees the R&D activities of Alaska, Hawaii, Washington, Oregon, California, Idaho, Nevada, Utah, and Arizona. These activities include research on geophysics, geochronology, earthquakes, landslide hazards, geochemistry, geologic mapping, climate change, oil and gas assessment, environmental monitoring and remediation, coal resource assessment, paleontology, and ecosystem analysis. Specific research activities in these regions involve using the USGS's four volcano observatories in Alaska, Washington, California, and Hawaii to study hazardous volcanoes and reduce losses; reducing earthquake hazards; and studying the geoenvironmental impacts of mercury and arsenic. One of the centers affiliated with this office is the Western Regional Coastal and Marine Geology Center, which conducts research on environmental quality and preservation, natural hazards and public safety, and natural resources and information technology as it relates to scientific instrumentation and data gathering. Specific research activities of this center include studying the marine sediment on the continental shelf south of Los Angeles to determine contamination amounts from historical sewage effluent discharges, conducting hydrothermal studies of the Gloria Ridge in Oregon, and conducting image mapping of sea floors. This federal R&D unit annually receives approximately \$70.8 million of federal R&D funds, which are dispersed throughout all the states in the western region, as are its employees.
- The Western Mapping Center is a unit of DOI's USGS. It is a production, research, and data management facility for maps and digital cartographic data products. This federal R&D unit annually receives approximately \$690,000 in federal R&D funds and has about 122 FTEs, 16 of whom are directly involved in R&D.

Moffett Field, California, is home to NASA's Ames Research Center and DOD's Aeroflightdynamics Research, Development, and Engineering Center's Applied Technology Directorate.

- The Ames Research Center is a unit of NASA. It conducts research on information technology, airspace operations systems, and astrobiology. Specific research activities focus on the exploration of life in the universe, the role of gravity in living systems, and the study of the Earth's atmosphere and ecosystems. Recent research projects have included the development of the Lunar Prospector spacecraft and a next-generation Internet architecture. This federal facility annually receives a total of approximately \$583 million, at least \$382 million of which directly involves R&D efforts. The center has about 1,478 FTEs, only a portion of whom are involved in R&D activities. A substantial portion of its funds is spent on the maintenance and operation of R&D equipment and facilities. In a recent year, over \$100 million of R&D contracts were awarded by the center, approximately \$67 million of which were made to entities based in California.
- The Aeroflightdynamics Directorate is a unit of DOD's Army Aviation Research, Development, and Engineering Center, headquartered in Huntsville, Alabama. A related directorate is at Fort Eustis, Virginia. It conducts R&D on all aspects of rotorcraft, including helicopters, tiltrotor aircraft, and other advanced rotary-wing aircraft. Specific major R&D activities of this unit include such areas as the aeromechanics, aerodynamics, design layout, structural dynamics, aeroelastic stability, flight controls, rotor loads and vibrations, pilot-vehicle interface, fluid controls, simulation, computational fluid dynamics, crew station design, and acoustics of all rotorcraft. This federal unit annually receives approximately \$22.5 million in federal R&D funds, approximately \$9.3 million of which are spent on in-house activities, and has about 118 civilian personnel, most of whom are directly involved in R&D activities. In October 1999, the Aviation Research, Development, and Engineering Center was provisionally merged with the Missile Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.

Monterey, California, is home to DOD's Naval Research Laboratory Fleet Numerical Meteorology and Oceanography Center and DOC's Monterey Bay National Marine Sanctuary.

- The Fleet Numerical Meteorology and Oceanography Center is a unit of DOD's Naval Research Laboratory headquartered in the District of Columbia. The center conducts R&D on atmospheric forecast systems. The center's research projects include the coupled ocean/atmosphere mesoscale prediction system, the Mediterranean gale force winds expert system, aerosols, and an automated tropical cyclone forecasting system. This federal unit annually receives approximately \$17.5 million of federal R&D funds, only a portion of which are spent on in-house activities, and has about 64 civilian personnel.
- The Monterey Bay National Marine Sanctuary is a unit of DOC's NOAA. Such sanctuaries conduct research on the marine environment to identify areas of special national significance stemming from their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific R&D activities of this unit include studying human disturbances in kelp forests, assessing coastal erosion, characterizing ocean currents, studying the oceanographic conditions of El Niño, determining why the sanctuary is critical for whales, and assessing the impacts of significant red tide events. This federal unit annually receives approximately \$140,000 of federal R&D funds and has about five FTEs.

Pacific Grove, California, is home to DOC's Pacific Fisheries Environmental Laboratory.

- The Pacific Fisheries Environmental Laboratory is a unit of the Southwest Fisheries Science Center inside DOC's NOAA. It conducts research on the link between the environment and fisheries, physical oceanography, and fisheries climatology. Recent research activities of this laboratory include assessing the trends in species composition and size distribution of fisheries,

examining the large-scale climatic variability and environment relationships in ecosystems, and developing methodologies for analyzing long-term trends and changes in both oceanographic and fisheries time series. This federal unit annually receives approximately \$970,000 of federal R&D funds and has about 10 FTEs, only a portion of whom are involved in R&D activities.

Palo Alto, California, is home to a DVA R&D unit.

- While the principal focus of the VA Palo Alto Health Care System facility, the VA Medical Center in Palo Alto, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 525 projects with total funding of approximately \$10.9 million. These R&D activities focus on a wide range of topics, including aging, Alzheimer's disease, cancer, spinal cord regeneration, and schizophrenia. The center's Rehabilitation Research and Development Center studies ways technology and engineering can assist the disabled—most specifically, computer-assisted, voice-activated robotic aid for quadriplegics and ultrasonic, head-controlled wheelchairs.

Pasadena, California, is home to NASA's Jet Propulsion Laboratory.

- The Jet Propulsion Laboratory is an FFRDC sponsored by NASA and operated by the California Institute of Technology. The laboratory conducts R&D in planets, Earth sciences, astrophysics, and telecommunications. Recent research activities include the Cassini mission to Saturn, the Microwave Limb Sounder to study the chemistry of Earth's upper atmosphere, the Space Infrared Telescope Facility (SIRTF) to study galaxy formation, and the Deep Space Network to image planets and asteroids. This federally owned and contractor-operated facility annually receives about \$1.1 billion of core funding, all of which is federal R&D funds, and has a workforce of 4,900 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Port Hueneme, California, is home to DOD's Naval Facilities Engineering Services Center and Naval Surface Warfare Center Port Hueneme Division.

- The Naval Facilities Engineering Services Center is a unit of DOD. It conducts R&D in defense environmental restoration, pollution prevention equipment, and Navy shore facilities improvement. This federal unit annually receives about \$31 million of federal R&D funds, approximately \$21 million of which are spent on in-house activities, and employs about 534 civilians, only a portion of whom are directly involved in R&D activities.
- The Naval Surface Warfare Center Port Hueneme Division is a unit of DOD. It tests and evaluates surface-warfare ship combat systems and subsystems, unique equipment, and related expendable ordnance of the Navy Surface Fleet. It provides system engineering, development, and integration of Navy shipboard offensive and defensive combat weapons systems. The specific R&D activities of this unit focus on testing and evaluating weapon systems, combat systems, operational software, and all aspects of deployed systems. This federal unit annually receives about \$24.8 million of federal R&D funds for in-house activities and has about 2,300 civilian personnel, only a small portion of whom are directly involved in R&D activities.

Point Mugu, California, is home to a unit of DOD's Naval Air Warfare Center Weapon Division.

- The Naval Air Warfare Center Weapon Division is a unit of DOD. The center is headquartered in China Lake, California, with additional units at the Missile Range in White Sands, New Mexico, and Port Mugu. The portion of the center housed in Port Mugu is the Pacific Missile Test Center. Its R&D activities focus on air-to-air and air-to-surface missiles; avionics hardware, software, and total-combat flight programs; and electronic and information warfare. This federal unit employs about 1,940 civilians, only a portion of whom are directly involved in R&D

activities. Its budget is included in that presented above for the center's headquarters in China Lake, California.

Redding, California, is home to USDA's Redding Silviculture Laboratory.

- The Redding Silviculture Laboratory is a unit of the Pacific Southwest Research Station inside USDA's Forest Service. It conducts research on developing concepts, information, and predictive models of the dynamic nature of Western forests and determining the effects of various management strategies on forest productivity, health, and sustainability. Specific research activities of this laboratory include studies to understand how site characteristics, soil factors, and soil processes interact to influence productivity. This federal R&D unit annually receives approximately \$1.9 million of federal R&D funds and has about 28 employees.

Riverside, California, is home to USDA's U.S. Salinity Laboratory, National Clonal Germplasm Repository for Citrus, and Riverside Forest Fire Laboratory.

- The U.S. Salinity Laboratory is a unit of USDA's ARS located on the campus of the University of California at Riverside. It is composed of three research divisions focusing on soil physics and pesticides, plant science, and soil and water chemistry. They conduct basic research on the biology, chemistry, and physics of salt-affected soil-plant-water systems, alternatives to methyl bromide, and virus transport in soil. This federal R&D unit, in combination with the National Clonal Germplasm Repository for Citrus described directly below, annually receives approximately \$4 million of federal R&D funds and has about 51 FTEs.
- The National Clonal Germplasm Repository for Citrus is a unit of USDA's ARS located on the campus of the University of California at Riverside. It is a repository that collects, maintains, evaluates, preserves, and distributes pathogen-free clonal

germplasm of citrus, 32 related Aurantioideae genera, and date palms and related species and maintains an informational file on each accession. Research at this unit is conducted cooperatively with university scientists. Specific research activities of this unit include characterizing and evaluating citrus and date palm germplasm, developing a core subset based on molecular characterization, and studying seasonal variations in CTV titer under field conditions. The funding and staffing for this federal R&D unit are included with those presented for the U.S. Salinity Laboratory described immediately above.

- The Riverside Forest Fire Laboratory is a unit of the Pacific Southwest Research Station inside USDA's Forest Service. It conducts research on fire meteorology, management, and effects; air pollution and global change impacts on Western forest ecosystems; and wildland recreation and urban cultures. Specific research activities of the fire laboratory include the development of improved seasonal weather forecasts for fire management, and the development of knowledge to improve the capability of land managers to measure, model, predict, and mitigate the behavior and effects of prescribed fire, wildfire, and other disturbances on southwestern ecosystems. This federal R&D unit annually receives approximately \$4.4 million of federal R&D funds and has about 60 employees.

Sacramento, California, is home to DOI's Western Ecological Research Center and California District Office of Water Resources.

- The Western Ecological Research Center is a unit of DOI's USGS. It conducts research to address ecological information needs, including such areas as herpetology, conservation biology, wetlands ecology, and ecological restoration. The center has 16 field stations scattered throughout California in Redwood, Dixon, Pacific Coast, Point Reyes, the San Francisco Bay, Golden Gate, Santa Cruz, Yosemite, Kings Canyon, Piedras Blancas, Channel Islands, San Diego, Box Springs, San Simeon, Canyon Crest, Kern, and Davis. Specific research activities of

the center and its field units include studying the anthropogenic degradation of the southern California desert ecosystem, investigating declining species, and studying the ecology of the western pond turtle in the Mojave River. This federal R&D unit annually receives approximately \$3.9 million in federal R&D funds and has about 102 FTEs.

- The California District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$12.4 million in federal R&D funds.

Salinas, California, is home to USDA's Agricultural Research Station.

- The U.S. Agricultural Research Station is a unit of USDA's ARS. It conducts research on sugarbeets, vegetables, and melons. Specific research activities include breeding and genetics; control of viral, fungal, and bacterial diseases; weed control; and developing alternatives to methyl bromide for soilborne disease control. This federal R&D unit annually receives approximately \$2.6 million of federal R&D funds and has about 34 FTEs.

San Diego, California, is home to DOD's Naval Health Research Center, Space and Naval Warfare Systems Command and San Diego Systems Center, the Navy Personnel Research and Development Center, a unit of the Office of Naval Research, the Defense Technical Information Center's MATRIS Office, and a DVA R&D unit.

- The Naval Health Research Center is a unit of DOD. It conducts R&D on the biomedical and psychological aspects of the Navy and Marine Corps. Research areas include health and physical readiness, alcohol rehabilitation, and understanding the processes that lead to physical and mental performance degradation. Specific R&D projects have focused on the effects of exposure to environmental stressors (e.g., heat, cold, gravitational forces); identifying, developing, and evaluating countermeasures to performance degradation of environmental stressors; and measuring and understanding the physiological effects of protective gear on the individual. This federal unit annually receives about \$15 million of federal R&D funds, approximately \$4.7 million of which are spent on in-house activities, and employs 60 civilians, only a portion of whom are directly involved in R&D activities.
- The Space and Naval Warfare Systems (SPAWAR) Command is a unit of DOD. In addition to its headquarters unit, the command has two field stations that conduct R&D, known as Systems Centers, located in San Diego and Charleston, South Carolina. It conducts R&D on the collection, transmission, processing, display, and management of information essential for naval and warfare operations. Specific research activities of this unit include studies in atmospheric physics, electro-optics, underwater acoustics, engineering psychology, signal propagation and processing, artificial intelligence, material sciences, microelectronics, chemical oceanography, and environmental and biological sciences. This federal unit annually receives about \$445.7 million of federal R&D funds, approximately \$222.8 million of which are spent on in-house activities, and has about 1,085 civilian personnel, only a portion of whom are directly involved in R&D activities.

- The Space and Naval Warfare Systems Center in San Diego is a unit of DOD. It is a part of SPAWAR Command, also located in San Diego, and has an East Coast counterpart unit in Charleston, South Carolina. This center conducts R&D in the areas of command, control, communications, intelligence, surveillance, reconnaissance, and navigation. Specific R&D activities of this unit focus on undersea surveillance, communications networks, data links for information transfer, information assurance, military planning, navigation improvements, targeting threats, marine mammal use for harbor defense, environmental science for base/port environmental assessments, and wireless networks to improve connectivity. This federal unit annually receives about \$224.8 million of federal R&D funds, approximately \$98.5 million of which are for in-house activities, and has about 3,529 civilian personnel, only a portion of whom are directly involved in R&D activities. Virtually all of these R&D funds are provided to the center on a reimbursable basis to cover the costs of work being done for a variety of units throughout DOD and are therefore already reflected in amounts contained elsewhere in this report. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Navy Personnel Research and Development Center (NPRDC) is a unit of DOD. It conducts R&D on manpower and personnel. The center's R&D program encompasses recruiting, selection, and classification; personnel planning and policy analysis; distribution and assignment; knowledge management systems; personnel surveys; and program evaluation. A recent project focused on developing a comprehensive program to improve the Navy's management of its personnel resources. In November 1999, the NPRDC moved to Millington, Tennessee, and became known as the Navy Personnel Research, Studies, and Technology Department, a component of the Navy Personnel Command. This federal unit annually receives about \$8.4 million of federal R&D funds, approximately \$4.6 million of which are spent on in-house activities, and employs about 79

civilians, only a portion of whom are directly involved in R&D activities.

- The R&D Management Command is a unit of the Office of Naval Research (ONR) inside DOD. ONR is headquartered in Arlington, Virginia, and provides R&D managers to oversee the extramural R&D programs of the Navy and Marine Corps performed by universities, nonprofit organizations, or for-profit companies. ONR sponsors extramural R&D programs in information, electronics, and surveillance; ocean, atmosphere, and space; engineering, materials, and physical science; human systems; and naval expeditionary warfare. This federal unit annually receives approximately \$699,000 of federal R&D funds to support the in-house management activities of about 15 FTEs.
- The Manpower and Training Research Information System (MATRIS) Office is the unit of DOD's Defense Technical Information Center (DTIC) that provides information services in the fields of manpower, personnel, training, human factors, biomedicine, human safety, and human survivability to facilitate communications among researchers and prevent duplicative R&D efforts. This federal unit annually receives approximately \$750,000 of federal R&D funds and employs about eight people.
- While the principal focus of the VA San Diego Healthcare System facility, the VA Medical Center in San Diego, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 839 projects with total funding of approximately \$7.7 million. These R&D activities focus on a wide range of topics, including AIDS, Alzheimer's disease, geropsychiatry, substance abuse, nursing service, diabetes, cardiology, and cardiac surgery.

San Francisco, California, is home to DOC's Gulf of Farallones and Cordell Bank National Marine Sanctuaries and a DVA R&D unit.

- The Gulf of Farallones and Cordell Bank National Marine Sanctuaries are units of the DOC's NOAA. Such sanctuaries conduct research on the marine environment to identify areas of special national significance stemming from their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific R&D activities of these sanctuaries include the conduct of baseline studies of populations and habitats critical in the region, studying water quality, assessing habitats, and identifying the biological and behavioral characteristics of harbor seals. Other R&D activities include identifying the dynamics of the lush feeding ground for many marine mammals, seabirds, algae, invertebrates, endangered humpback whales, Dall's porpoises, albatross, shearwaters, and other marine species. Together, these federal units annually receive approximately \$144,000 of federal R&D funds and have two FTEs.
- While the principal focus of the San Francisco VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 485 projects with total funding of approximately \$5.4 million. These R&D activities focus on a wide range of topics, including heart disease, aging, brain, HIV, gene expression, liver diseases, and substance abuse.

San Marino, California, is home to the Smithsonian Institution's West Coast Research Center.

- The West Coast Research Center is one of two regional units of the Smithsonian's Archives of American Art, headquartered in the District of Columbia. It is the only regional center to conduct research on-site, however. The archive conducts research on the visual arts in America, using primary source documentation. The overall archive (i.e., the headquarters and both regional centers) annually receives approximately \$830,000 of federal R&D funds, most of which is spent in the District of Co-

lumbia. The West Coast Research Center has an annual budget of approximately \$100,000 and a staff of one, who generally spends about 10 percent of the time conducting research.

Santa Barbara, California, is home to DOC's Channel Islands National Marine Sanctuary.

- The Channel Islands National Marine Sanctuary is a unit of DOC's NOAA. Such sanctuaries conduct research on the marine environment to identify areas of special national significance stemming from their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific R&D activities of this unit include studying the sea floor using an underwater remotely operated vehicle; studying whale habitat and prey; studying the Ice Age through the system of stacked delta deposits that fringe the southern margin of the Santa Barbara Channel; and identifying the effects of shore runoff. This federal unit annually receives approximately \$71,000 of federal R&D funds and has one FTE.

Santa Cruz, California, is home to DOC's Tiburon (Santa Cruz) Laboratory.

- The Tiburon (Santa Cruz) Laboratory is a unit of the Southwest Fisheries Science Center inside DOC's NOAA. It studies the causes of variability in the abundance and health of fish populations, analyzes ecological relations in marine communities, and studies the economics of exploiting and protecting natural resources. The groundfish being studied at the laboratory include rockfishes, flatfishes, Pacific whiting, sablefish, and lingcod. The salmon being studied include coho, chinook, and steelhead. This federal unit has annually receives approximately \$2.7 million of federal R&D funds and has about 29 FTEs, only a portion of whom are involved in R&D activities.

Santa Monica, California, is home to DOD's Project AIR FORCE, Arroyo Center, and National Defense Research Institute.

- The Arroyo Center is an FFRDC sponsored by the Army and operated by RAND. The center helps the Army adapt to and stay ahead of changes in the world, define radical and different ways of operating, and maintain objectivity and balance on sensitive topics. It conducts research and analysis on such diverse areas as the connection between the Army's land management and environmental problems and the Army's logistics management system. This federally owned and contractor-operated R&D unit employs approximately 75 people and annually receives about \$18 million of core funding, all of which is federal R&D funds.
- Project AIR FORCE is an FFRDC sponsored by the Air Force and operated by RAND. It provides the Air Force with independent analyses of policy alternatives affecting the development, deployment, combat readiness, and support of current and future aerospace forces. Research activities focus on global engagements; aerospace force development; aircraft survivability; manpower, personnel, and training; resource management; weapons costing; and strategy and doctrine. This federally owned and contractor-operated R&D unit employs approximately 105 people and annually receives about \$23 million of core funding, all of which is federal R&D funds.
- The National Defense Research Institute (NDRI) is an FFRDC sponsored by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies and operated by RAND. It conducts research on acquisition and technology policy, forces and resources policy, and international security and defense policy. Specific research activities of NDRI have focused on warfare in the information age, implications of new technology for national security, how the worldwide military situation is changing and how these changes affect U.S. interests, ways to develop and acquire effective military forces, the enlargement of NATO, U.S. aircraft carrier production, and integrating women into the military. This federally owned and contractor-operated R&D unit employs approximately 78 people and annually receives about \$22 million of core funding, all of which is federal R&D funds.

Shafter, California, is home to USDA's Western Integrated Cropping Systems Research Unit.

- The Western Integrated Cropping Systems Research Unit, also known as the Shafter Research Laboratory, is a unit of USDA's ARS. It conducts research on the development of modern, sustainable systems for the production of cotton and other irrigated crops. Specific research activities include developing the Shafter Airborne Multispectral Remote Sensing System, a system designed to be flown aboard a light aircraft to acquire high-resolution images of the Earth's surface in different wavelengths of light. This federal R&D unit annually receives approximately \$915,000 of federal R&D funds and has about 16 FTEs.

Stanford, California, is home to DOE's Stanford Linear Accelerator Center.

- The Stanford Linear Accelerator Center is an FFRDC sponsored by DOE and operated by Stanford University. This center conducts basic research on the structure of matter at the atomic level, using X rays, and, at much smaller levels, using electron and positron beams. This federally owned and contractor-operated center annually receives approximately \$175 million of core funding and conducts an estimated \$166 million of specific R&D projects. The center has about 1,300 employees. A portion of the center's funds is spent on the maintenance and operation of R&D equipment and facilities.

Fresno, Loma Linda, Long Beach, Pleasant Hill, and Sepulveda, California, are home to VA Medical Centers. While the principal focus of all of these facilities is providing medical care to veterans, each center is also the location of a number of research activities. In a recent year, these federally owned and operated facilities have been the sites of 1,129 R&D projects with total funding of close to \$7 million. These R&D activities focus on a variety of topics, including spinal cord injuries, Alzheimer's disease, osteoporosis, and congestive heart failure.

FEDERAL R&D GRANTS TO CALIFORNIA ENTITIES

Every major institution of higher education in California is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of California (U of Calif), Stanford University, the University of Southern California (USC), California Institute of Technology (Caltech), California State University (Cal State), Loma Linda University, and the Charles R. Drew University of Medicine and Science (Drew). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of California are ones from DOE (\$47 million), NASA (\$35 million), the Environmental Protective Agency (EPA) (\$13 million), USDA (\$12 million), DOC (\$6 million), and the Department of Education (\$6 million). The comparable grants going to Stanford include \$11 million from NASA, \$7 million from DOE, and \$4 million from the Department of Trans-

Table 5.1 – Sources of Federal R&D Grants to Higher Education in California

	HHS		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Calif	\$759M	3,330	\$163M	2,270	\$88M	458	\$124M	2,037	\$1,134M	8,095
Stanford	\$175M	680	\$23M	347	\$26M	121	\$24M	183	\$249M	1,331
USC	\$99M	312	\$16M	213	\$11M	71	\$6M	78	\$132M	674
Caltech	\$27M	151	\$24M	230	\$16M	73	\$19M	155	\$86M	609
Cal State	\$23M	119	\$11M	189	\$3M	19	\$11M	109	\$48M	436
Loma Linda	\$4M	25	<\$1M	3	0	0	\$3M	2	\$7M	30
Drew	\$6M	17	0	0	<\$1M	1	0	0	\$6M	18
Other	\$5M	40	\$4M	93	\$1M	6	\$5M	58	\$14M	197
Total	\$1,099M	4,674	\$241M	3,345	\$145M	746	\$191M	2,622	\$1,676M	11,390

portation. Most of the dollars in this category going to Caltech came equally from DOE and NASA.

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Scripps Institution of Oceanography Graduate Department at the University of California at San Diego. These higher education institutions in California also received R&D grants in the neighborhood of \$68 million from DOE and \$61 million from NASA in FY 1998.

Several other nonacademic institutions in California also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Scripps Research Institute in La Jolla (\$116 million), Science Applications International Corporation (SAIC) in San Diego (\$63 million), Salk Institute for Biological Studies in La Jolla (\$36 million), City of Hope National Medical Center in Duarte (\$22 million), Burnham Institute in La Jolla (\$21 million), Lawrence Berkeley National Laboratory in Berkeley (\$17 million), and RAND in Santa Monica (\$17 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in California received 852 SBIR awards totaling \$230 million. Examples include a \$500,000 award from the Department of Transportation to Akela, Inc., in Santa Barbara to study the feasibility of using impulse radar to detect and identify detonators and a \$700,000 award from HHS to Metrika Laboratories, Inc., in Mountain View to develop a digital single-use total and HDL cholesterol self-test.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula

grants benefiting California are ones valued at more than \$5.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in California every year to foster research into water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN CALIFORNIA

Several entities in California also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go from DOD to Lockheed Martin Corporation, which in FY 1998 received close to \$775 million in contracts for R&D work on such programs as the Theater High-Altitude Air Defense (THAAD) system for the Army and the Space-Based Infrared System for the Air Force. In addition, TRW (\$647 million), Boeing Company (\$565 million), SAIC (\$339 million), and McDonnell Douglas Corporation (\$298 million) received very large R&D contracts from federal agencies in FY 1998. Included among these awards is one for approximately \$17 million for the operation of the Energy Technology Engineering Center (ETEC) for DOE. Note that these amounts are in addition to any federal R&D grants also received by these companies. For example, SAIC received close to \$63 million in R&D grants from HHS in FY 1998. Stanford (\$69 million), the University of California (\$64 million), USC (\$29 million), and Caltech (\$15 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$276 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities in California. By far the largest of these cooperative agreements (\$34 million in FY 1998) came from NSF to Caltech in Pasadena for operation and supporting R&D of the Laser Interferometer Gravitational-Wave Ob-

servatory (LIGO). Another of these cooperative agreements (\$8 million in FY 1998) came from DOC to the University of California's Scripps Institution of Oceanography to operate the Joint Institute for Marine Observations (JIMO). Other federal agencies awarding cooperative agreements to California-based entities include DOE, DOC, DOD, and NSF. Among these latter cooperative agreements are awards supporting five of NSF's Science Technology Centers—the Center for Engineering Plants for Pathogen Resistance at the University of California at Davis; the Center for Clouds, Chemistry, and Climate at University of California at San Diego; the Southern California Earthquake Center at the University of Southern California (cofunded by DOI's USGS); the Center for Quantized Electronic Structures at the University of California at Santa Barbara; and the Center for Particle Astrophysics at the University of California at Berkeley. In addition, California is home to four of NSF's Materials Research Science and Engineering Centers—the Center for Magnetic Recording Research at the University of California at San Diego; the Materials Research Science and Engineering Center at the University of California at Santa Barbara; the Center for Materials Research at Stanford University; and the Center for Polymer Interfaces and Macromolecular Assemblies jointly supported by Stanford University, IBM-Almaden, and the University of California at Davis.

Chapter 6

Federal Research and Development in Colorado

- Approximately \$1.4 billion of federal R&D funds are spent each year in Colorado.
- Colorado ranks 16th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 13 percent of all federal funds spent in Colorado each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

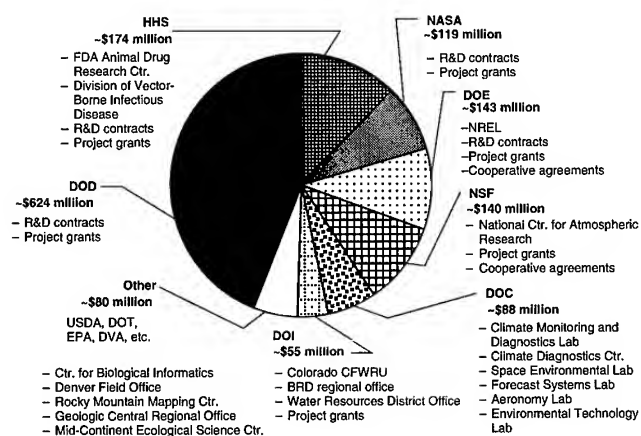


Figure 6.1 – Sources of Federal R&D Dollars Spent in Colorado
(Total Federal R&D ~\$1.4 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$1.4 billion annually in Colorado on research and development (R&D) activities. On average, federal R&D dollars account for approximately 13 percent of all federal funds spent in Colorado each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Colorado. Foremost among these agencies is the Department of Defense (DOD), which accounts for 44 percent of all federal R&D dollars spent in the state. The Department of Health and Human Services (HHS), the Department of Energy (DOE), the National Science Foundation (NSF), and the National Aeronautics and Space Administration (NASA) account for 12, 10, 10, and 8 percent, respectively. The remaining federal R&D dollars come collectively from the Departments of Commerce (DOC), Interior (DOI), Agriculture (USDA), and several other agencies.⁶

All federal R&D dollars spent in Colorado either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Colorado.

FEDERAL R&D UNITS IN COLORADO

Akron, Colorado, is home to USDA's Central Great Plains Research Station.

- The Central Great Plains Research Station is a unit of USDA's Agricultural Research Service (ARS). It is on the Akron campus of Colorado State University. The unit develops integrated cropping systems and technologies for maximum utilization of soil and water resources. Specific research activities include

⁶ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

developing techniques for the efficient use of plant nutrients, pesticides, and water and soil conservation and preservation. This federal R&D unit annually receives approximately \$1.3 million of federal R&D funds and has about 24 FTEs.

Boulder, Colorado, is home to DOC's Climate Monitoring and Diagnostics Laboratory, Climate Diagnostics Center, Space Environmental Laboratory, Forecast Systems Laboratory, Aeronomy Laboratory, and Environmental Technology Laboratory, and NSF's National Center for Atmospheric Research.

- The Climate Monitoring and Diagnostics Laboratory is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts research related to atmospheric constituents that are capable of forcing change in the climate of the earth through modification of the atmospheric radiative environment—for example greenhouse gases and aerosols—and those that may cause depletion of the global ozone layer. This federal unit annually receives approximately \$6.3 million of federal R&D funds and has about 46 FTEs.
- The Climate Diagnostics Center is a unit of DOC's NOAA. It conducts research to identify the causes and potential predictability of important climate phenomena. Specific areas of research activities include major droughts and floods, the El Niño–Southern Oscillation and its global impacts, and decadal to centennial climate variations. It also performs extensive intercomparisons of observational and climate model data, an activity essential to improving climate models and forecasts. This federal unit annually receives approximately \$3.4 million of federal R&D funds and has about nine FTEs.
- The Space Environmental Laboratory is a unit of DOC's NOAA. It conducts research on solar-terrestrial physics, develops techniques for forecasting solar and geophysical disturbances, and provides real-time monitoring and forecasting of solar and geophysical events. Its researchers study the sun's electromagnetic, particle, and magnetic-field emissions and the

processes by which they affect earth's space environment. It also takes a leading role in designing new data systems that will fly on government satellites. This federal unit annually receives approximately \$5.2 million of federal R&D funds and has about 55 FTEs.

- The Forecast Systems Laboratory is a unit of DOC's NOAA. It conducts research to improve data analyses and forecast systems, to improve methods for understanding atmospheric processes, and to validate systems utilizing real-time and archived data to test and evaluate new diagnostic and forecast techniques. This federal unit annually receives approximately \$11.8 million of federal R&D funds and has about 68 FTEs.
- The Aeronomy Laboratory is a unit of DOC's NOAA. It conducts fundamental research on the chemical and physical processes of the Earth's atmosphere, concentrating on the two layers known as the troposphere and stratosphere. Through laboratory, modeling, and field research, it focuses on chemical and physical processes related to the ozone layer, the climate system, and air quality. This federal unit annually receives approximately \$8.6 million of federal R&D funds and has about 43 FTEs.
- The Environmental Technology Laboratory is a unit of DOC's NOAA. It conducts oceanic and atmospheric research and develops innovative remote sensing systems and techniques. It studies all aspects of the interaction of radio, light, and sound waves with the ocean and atmosphere to probe remote regions and meet the challenges posed by weather and climate. This federal unit annually receives approximately \$4.9 million of federal R&D funds and has about 68 FTEs.
- The National Center for Atmospheric Research (NCAR) in Boulder, Colorado, is a federally funded research and development center (FFRDC) sponsored by NSF and managed by the University Corporation for Atmospheric Research. NCAR's mission is to plan, organize, and conduct atmospheric and re-

lated research programs in collaboration with universities, to provide state-of-the-art research tools and facilities to the entire atmospheric sciences community, to support and enhance university atmospheric research education, and to facilitate the transfer of technology to both the public and private sectors. NCAR's research includes atmospheric and environmental modeling, chemistry and biogeochemistry, climate, weather, solar research and solar-terrestrial interactions, atmospheric remote sensing, and airborne instrumentation. This federal R&D unit annually receives approximately \$75 million of federal R&D funds and has about 750 employees.

Denver, Colorado, is home to DOI's Center for Biological Informatics, Denver Field Office, Biological Resources Division, Rocky Mountain Mapping Center, and Geologic Central Regional Office; HHS's Animal Drug Research Center; and a Department of Veterans Affairs (DVA) R&D unit.

- The Center for Biological Informatics is a unit of DOI's U.S. Geological Survey (USGS). It conducts research on developing and providing standards and procedures for acquiring, managing, and sharing biological data and information. Specific research activities of the center include providing regional assessments of the conservation status of native vertebrate species and natural land cover types and facilitating the application of this information to land management activities. Other research activities focus on using remotely sensed data and dynamic spatial models to help scientists analyze current habitat conditions and the effects of the changing environment on the biological resources of the nation. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about 20 FTEs.
- The Denver Field Office is a unit of the Mid-Continent Ecological Science Center inside DOI's USGS. It conducts research on regulated ecosystem research in cooperation with the DOI Bureau of Reclamation. Specific research activities of this unit include river systems management and in-stream and riparian

ecology. This federal R&D unit annually receives approximately \$1.3 million of federal R&D funds and has about eight FTEs.

- The Biological Resources Division Central Regional Office inside DOI's USGS has direct line authority over the four science centers in its region. The office coordinates science and operational activities among the Central Region's centers and integrates with the Eastern and Western Regions. The office also provides research expertise to other Department of Interior bureaus and serves as coordinator and integrator of this activity within DOI as well. In addition, a cooperative unit coordinator/eastern supervisor is located in Denver. Altogether, this federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about 13 FTEs.
- The Rocky Mountain Mapping Center is a unit of DOI's USGS. It conducts mapping activities in the western U.S. These include the production of digital elevation and planimetric data, production of graphic maps, and development of new mapping techniques. Specific research activities of this center include research in environmental sciences, physical sciences, cartography, and geographic information systems. The unit also maintains the worldwide distribution facility for more than 100,000 different maps, open-file reports, and other products of federal agencies. This federal R&D unit annually receives approximately \$1.9 million in federal R&D funds and has about 366 FTEs, 55 of whom are directly involved in R&D.
- The Geologic Central Regional Office is a unit inside DOI's USGS. It oversees the R&D activities of Montana, Wyoming, Colorado, New Mexico, Texas, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Minnesota, Iowa, Missouri, Arkansas, and Louisiana. These activities include research on geophysics, geochronology, earthquakes, landslide hazards, geochemistry, geologic mapping, climate change, oil and gas assessment, environmental monitoring and remediation, coal re-

source assessment, paleontology, and ecosystem analysis. Specific research activities in these regions focus on assessing the natural gas and petroleum potential for Montana, geologic mapping of the Omaha-Kansas City urban corridor, and studying the impacts of climate change and land use on the southwestern United States. One of the centers affiliated with this office is the national Earthquake information Center in Golden, Colorado. This federal R&D unit annually receives approximately \$53.4 million of federal R&D funds, which are dispersed throughout all the states of the central region, as are its employees.

- The Animal Drug Research Center is a unit of HHS's Food and Drug Administration. It conducts research on animal drugs and medicated feeds to ensure that they are safe and effective for their intended uses and that food from treated animals is safe for human consumption. The center is particularly concerned with animal drug residue testing. Co-located with the center is the FDA's Denver District Laboratory. It conducts research on the safety and efficacy of human drugs and the safety and nutritional content of foods. Together these federal units annually receive approximately \$812,000 of federal R&D funds and have about 12 FTEs directly involved in R&D activities.
- While the principal focus of the Denver VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 253 projects with total funding of approximately \$5 million. These R&D activities focus on a wide range of topics, including drug therapy, chemotherapy, neoplasms, HIV, genetics, and schizophrenia.

Fort Collins, Colorado, is home to DOI's Mid-Continent Ecological Science Center and Colorado Cooperative Fish and Wildlife Research Unit; USDA's Natural Resources Research Center, Crops Research Laboratory, National Seed Storage Laboratory, Rocky Mountain Research Station, and National Wildlife Research Center; and HHS's Division of Vector-Borne Infectious Diseases.

- The Mid-Continent Ecological Science Center is a unit of DOI's USGS. It conducts research to develop, integrate, and provide ecological knowledge necessary to understand the causes and predict the consequences of change in order to improve the conservation and management of natural resources in interior western landscapes. The center also develops and implements inventory and monitoring programs for the accurate assessment of biological status and trends and provides information, technical services, and training related to the management of biological resources. Specific research activities of this center include ecological research on native western species, water resources ecology and management; ecosystem analysis in support of public land management; and social science analysis in support of natural resources decisions. This federal R&D unit annually receives approximately \$7.4 million of federal R&D funds and has about 89 FTEs.
- The Colorado Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Colorado State University. It conducts research on the management of fishery and wildlife resources, educates fishery and wildlife biologists at the graduate level, and provides technical assistance to the conservation agencies and groups. Specific research activities of this unit include population biology, habitat management, and parasitic interactions. This federal R&D unit annually receives approximately \$350,000 of federal R&D funds and has about three FTEs.
- The Natural Resources Research Center is a unit of USDA's ARS. It is on the Fort Collins campus of Colorado State University with three other ARS research units. One of the center's divisions conducts research on water conservation and water quality as impacted by management and on the development and application of a decision support system for farmers and ranchers in the Great Plains. Another division conducts research to develop irrigation, agricultural chemical, and other management practices that protect water quality. And yet an-

other division conducts research to develop and evaluate the new knowledge required to efficiently manage soil, fertilizer, and plant nutrients (especially nitrogen) to achieve optimum crop yields, maximize farm profitability, maintain environmental quality, and sustain long-term productivity. This federal R&D unit, in combination with the two units described immediately below, annually receives approximately \$11.3 million in federal R&D funds and has about 135 FTEs.

- The Crops Research Laboratory is a unit of USDA's ARS. On the Fort Collins campus of Colorado State University with three other ARS research units, it conducts research to identify and produce sugar beet germplasm exhibiting superior disease and stress tolerance and agronomic qualities; improve production efficiency and biochemical processing characteristics of sugar beets; and adapt biotechnologies to modify host-pathogen relations that affect sugar beet disease resistance, pathogenesis, and epidemiology. Specific research activities of this unit include investigating the causes of sucrose losses and chemical quality decreases for sugar beets stored in outdoor piles for long periods before processing and looking into biological disease controls as a means of maximizing production efficiency and reducing environmental risks inherent in the use of pesticides. The federal R&D funds and staff information for this federal R&D unit are included above in those provided for the Natural Resources Research Center.
- The National Seed Storage Laboratory is a unit of USDA's ARS. On the Fort Collins campus of Colorado State University with three other ARS research units, it is composed of two research divisions focusing on plant germplasm and seed viability and storage. The laboratory preserves the base collection of plant germplasm for the National Plant Germplasm System; determines the initial quality of germplasm and periodically monitors the viability of the plant germplasm in storage; and maintains the National Seed Storage Laboratory database and the Germplasm Resources Information Network. Specific research

activities of the lab include developing methods to preserve plant propagules of species and accessions not currently in the base collection and to evaluate conventional and cryogenic storage protocols and develop strategies to improve cost efficiency. The federal R&D funds and staff information for this federal R&D unit are included above in those provided for the Natural Resources Research Center.

- The Rocky Mountain Research Station, headquartered in Fort Collins, is a unit inside USDA's Forest Service. It conducts research on fisheries and watersheds, climate change and air resources, recreation benefits, biological diversity, and ecological processes and ecosystem health. Specific research activities of this unit include studying aquatic and riparian ecosystems, investigating alpine and forest ecosystems under atmospheric and terrestrial disturbances, and identifying and evaluating wildland resource benefits. This federal R&D unit annually receives approximately \$4.9 million of federal R&D funds and has about 52 employees.
- The National Wildlife Research Center is a unit of the Animal and Plant Health Inspection Service inside USDA. It conducts research to resolve problems caused by the interaction of wild animals and society. Specific research activities of this center include developing strategies to control blackbird damage in the United States, studying the use of biotechnology and immun contraceptive vaccines to solve wildlife problems, identifying new techniques to reduce rodent damage to crops and rangeland, and developing ways to reduce the threat of wildlife to aviation. This federal R&D unit annually receives approximately \$8.9 million of federal R&D funds and has about 121 employees.
- The Division of Vector-Borne Infectious Diseases (DVBID) is a unit of the National Center for Infectious Diseases inside HHS's Centers for Disease Control and Prevention (CDC), headquartered in Atlanta, Georgia. DVBID is composed of the Arbovirus Diseases Branch, the Bacterial Zoonoses Branch, and the

Dengue Branch. The Dengue Branch is separately located in San Juan, Puerto Rico. DVBID conducts laboratory and epidemiologic research to improve diagnosis, surveillance, prevention, and control of diseases of major public health importance, such as Lyme disease, dengue/dengue hemorrhagic fever, yellow fever, arboviral encephalitis, and plague. Additional expertise is maintained for other vector-borne infectious diseases that occur only sporadically or in periodic epidemics. DVBID serves as a national and international reference center for vector-borne viral and bacterial diseases. Specific research activities of the division include developing surveillance for vector-borne viral and bacterial agents and their arthropod vectors; conducting field and laboratory research and epidemic aid investigations; and providing diagnostic reference and epidemiologic consultation to state and local health departments, other components of CDC, other federal agencies, and national and international health organizations. This federal unit annually receives approximately \$8.4 million of federal R&D funds and has about 72 FTEs.

Golden, Colorado, is home to DOE's National Renewable Energy Laboratory.

- The National Renewable Energy Laboratory is an FFRDC sponsored by DOE and operated by Midwest Research Institute, Battelle Memorial Institute, and Bechtel National, Inc. It conducts R&D on renewable energy and energy efficiency. Specifically, it develops renewable energy technologies, improves energy efficiency, advances related science and engineering, and facilitates commercialization. Current research activities include photovoltaics, wind energy, biomass-derived fuels and chemicals, energy-efficient buildings, advanced vehicles, solar manufacturing, industrial processes, solar thermal systems, hydrogen fuel cells, superconductivity, and geothermal and waste-to-energy technologies. This federally owned and contractor-operated laboratory annually receives approximately \$165 million of core funding, all of which is spent on specific R&D projects, and has about 900 employees. A portion of the labo-

ratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

Lakewood, Colorado, is home to DOI's Colorado District Office of Water Resources.

- The Colorado District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$11.7 million in federal R&D funds.

FEDERAL R&D GRANTS TO COLORADO ENTITIES

Every major institution of higher education in Colorado is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, NASA, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Colorado, Colorado State University (CSU), the University of Denver, and the Colorado School of Mines (CSM). The table below shows the number of R&D grants active in FY 1998, highlighting those made by

HHS, NSF, NASA, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Colorado are ones from DOE (\$5 million), DOC (\$1 million), and the Department of Education (\$1 million). The comparable grants going to CSU include \$4 million from USDA, \$3 million from DOE, and \$2 million from the Environmental Protection Agency (EPA).

Table 6.1 – Sources of Federal R&D Grants to Higher Education in Colorado

	HHS		NSF		NASA		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Colorado	\$121M	567	\$30M	407	\$11M	293	\$8M	72	\$9M	82	\$178M	1,421
CSU	\$23M	136	\$10M	164	\$2M	36	\$2M	15	\$10M	218	\$47M	569
U of Denver	\$3M	30	\$1M	28	\$1M	9	0	0	<\$1M	3	\$5M	70
CSM	<\$1M	1	\$2M	46	<\$1M	4	\$1M	11	\$1M	17	\$4M	79
Other	\$1M	7	<\$1M	10	<\$1M	2	0	0	<\$1M	2	\$1M	21
Total	\$147M	741	\$43M	655	\$14M	344	\$11M	98	\$20M	322	\$235M	2,160

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Health Sciences Center at the University of Colorado.

Several other nonacademic institutions in Colorado also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the National Jewish Medical and Research Center in Denver (\$23 million), the AMC Cancer Research Center and Hospital in Lakewood (\$7 million), and the American Water Works Association in Denver (\$5 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research

(SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Colorado received 199 SBIR awards totaling \$48 million. Examples include a \$1.9 million award from DOD (Ballistic Missile Defense Organization) to Macro-Vision Communications in Boulder for work on high-density, reconfigurable optical routing interconnects and a \$750,000 award from DOE to Ada Technologies, Inc., in Englewood to develop energy-saving intelligent controls for commercial/industrial refrigeration.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Colorado are ones valued at more than \$2.8 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Colorado every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN COLORADO

Several entities in Colorado also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from DOD to Lockheed Martin in Littleton, which in FY 1998 received close to \$1.1 billion in R&D contracts, primarily to fund its Air Force-sponsored work on Titan and Atlas launch vehicle assembly and flight operations. In addition, Antarctic Support Associates (\$124 million), Ball Aerospace and Technologies (\$43 million), Kaman Sciences Corp. (\$40 million), Johnson Engineering Corp. (\$23 million), and ITT Systems and Sciences Corp. (\$15 million) received very large R&D con-

tracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by these companies. The University of Colorado (\$38 million) and CSU (\$3 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$171 million of federal R&D dollars was also received in FY 1998 by entities located in Colorado in the form of cooperative agreements. One notable cooperative agreement came from DOC to Colorado State University at Boulder to operate the Cooperative Institute for Research in Environmental Sciences (CIRES) (\$25 million in FY 1998). Another came from DOC to the University of Colorado to operate the Cooperative Institute for Research in the Atmosphere (CIRA) (\$8.4 million in FY 1998). Other federal agencies awarding cooperative agreements to Colorado-based entities include DOC, DOE, and NSF. Among these latter cooperative agreements is an award supporting one of NSF's Materials Research Science and Engineering Centers—the Ferroelectric Liquid Crystal Research Center at the University of Colorado at Boulder.

Chapter 7

Federal Research and Development in Connecticut

- Approximately \$819 million of federal R&D funds are spent each year in Connecticut.
- Connecticut ranks 22nd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 9 percent of all federal funds spent in Connecticut each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

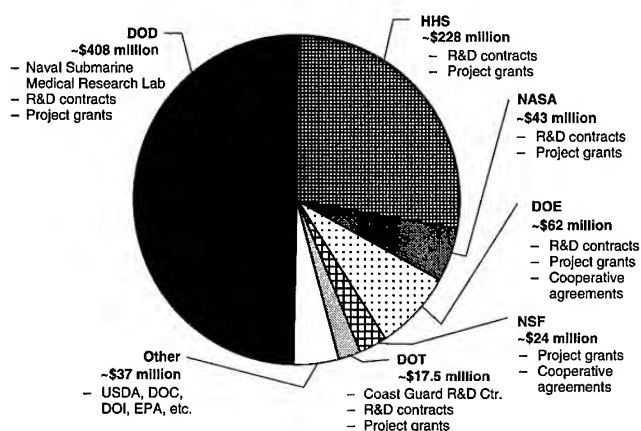


Figure 7.1 – Sources of Federal R&D Dollars Spent in Connecticut
(Total Federal R&D ~\$819 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$820 million annually in Connecticut on research and development (R&D) activities. On average, federal R&D dollars account for approximately 9 percent of all federal funds spent in Connecticut each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Connecticut. Foremost among these agencies are the Department of Defense (DOD) and the Department of Health and Human Services (HHS), which account for 50 and 28 percent of all federal R&D dollars spent in the state, respectively. The Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF) account for an additional 8, 5, and 3 percent of the federal R&D dollars spent in Connecticut, respectively. The remaining federal R&D dollars come collectively from the Department of Transportation (DOT), the Department of Agriculture (USDA), the Department of Commerce (DOC), and several other federal agencies.⁷

All federal R&D dollars spent in Connecticut either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Connecticut.

FEDERAL R&D UNITS IN CONNECTICUT

East Hartford, Connecticut, is home to Department of Interior's (DOI's) Connecticut District Office of Water Resources.

- The Connecticut District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Re-

⁷ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

sources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment Program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$448,000 in federal R&D funds.

Groton, Connecticut, is home to DOD's Naval Submarine Medical Research Laboratory and DOT's U.S. Coast Guard Research and Development Center.

- The Naval Submarine Medical Research Laboratory is a unit of DOD. It conducts R&D to enhance auditory and visual operator performance, health and physical standards, and closed environment atmospheric monitoring. Specifically, the laboratory conducts R&D to optimize crew survival rates in damaged submarines and to determine the effectiveness of contaminant control procedures by measuring concentrations of volatile organic compounds, oxygenated compounds, and ozone. This federal unit receives about \$3.8 million in federal funds, about \$2.7 million of which are spent on in-house activities, and has about 26 civilian personnel.
- The U.S. Coast Guard Research and Development Center is a unit of DOT's Coast Guard. It conducts research to develop hardware and systems to increase the quality and productivity of operations. Specific research activities of this center include im-

proving search and rescue capabilities, studying survival suit leeway, developing search planning theory, researching sensor fusion and ocean current data blending, studying fuel cell propulsion and robotics, and developing energy conservation technology. Other R&D activities include a study on the probability of detection of high-seas drift nets using the Navy's Sound Surveillance System. This federal R&D unit annually receives approximately \$13.7 million in federal R&D funds and has about 73 civilian employees.

Hamden, Connecticut is home to USDA's Northeastern Center for Forest Health Research.

- The Northeastern Center for Forest Health Research is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on the impact of insects on forest health. Specific research activities of this center include studying the biology of insect pests and their interaction with plants and environmental stressors and investigating the pathology and microbial control of insects that impact the health of eastern forests. With the help of an additional work unit in Durham, New Hampshire, the center also studies how the interactions of pathogens, stressors, and hosts create disturbances in forests. These federal R&D units annually receive approximately \$2.8 million in federal R&D funds and have about 32 employees.

Milford, Connecticut is home to DOC's Milford Laboratory.

- The Milford Laboratory is a unit of the Northeast Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). It researches aquaculture and habitat-related work. Specifically, the laboratory studies the culture of fish and shellfish in order to develop methods suitable for commercial use as well as for stock enhancement and restoration. This federal unit annually receives approximately \$2 million of federal R&D dollars and has about 28 FTEs, only a portion of whom are involved in R&D activities.

West Haven, Connecticut, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the VA Connecticut Healthcare System facility, the VA Medical Center in West Haven, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 486 projects with total funding of approximately \$12 million. These R&D activities focus on a wide range of topics, including psychiatry, alcoholism, drug abuse, posttraumatic stress disorders, and emission-computed tomography.

FEDERAL R&D GRANTS TO CONNECTICUT ENTITIES

Every major institution of higher education in Connecticut is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, DOE, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Yale University, the University of Connecticut (UConn), Wesleyan University, and the Connecticut State University system (CSU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by

Table 7.1 – Sources of Federal R&D Grants to Higher Education in Connecticut

Institution	HHS		NSF		DOE		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Yale	\$196M	823	\$13M	207	\$10M	24	\$6M	30	\$2M	45	\$227M	1,129
U of Conn	\$29M	164	\$8M	135	\$1M	12	\$3M	24	\$5M	95	\$46M	430
Wesleyan	\$2M	13	\$1M	26	0	0	0	0	<\$1M	2	\$3M	41
CSU	\$2M	5	<\$1M	1	0	0	0	0	<\$1M	1	\$2M	7
Other	\$2M	14	\$1M	13	<\$1M	1	<\$1M	1	<\$1M	6	\$3M	35
Total	\$231M	1,019	\$22M	382	\$11M	37	\$8M	55	\$8M	149	\$280M	1,642

HHS, NSF, DOE, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Nearly all of the grants in the "Other Agencies" category going to Yale University are from NASA. The comparable grants going to UConn include \$2 million each from USDA and the Department of Education.

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the School of Medicine at the UConn Health Center.

Several other nonacademic institutions in Connecticut also receive a significant amount of federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are Haskins Laboratories, Inc., in New Haven (\$3 million), Travelers Insurance Co. in Hartford (\$3 million), John B. Pierce Foundation Laboratory, Inc., in New Haven (\$2 million), and Steven Winter Associates, Inc., in Norwalk (\$1.5 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Connecticut received 96 SBIR awards totaling \$25 million. Examples include a \$750,000 award from DOD (Air Force) to Advanced Optical Technologies in East Hartford to develop an automated system for accurately tracking and measuring multiple targets in six dimensions and a \$600,000 award from NASA to Advanced Technology Materials, Inc., in Danbury for work on lightweight and inexpensive hydrogen-specific sensors.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula

grants benefiting Connecticut are ones valued at more than \$1.8 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Connecticut every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN CONNECTICUT

Several entities in Connecticut also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from DOD to Electric Boat Corp. (a subsidiary of General Dynamics) in Groton, which in FY 1998 received close to \$1.7 billion in R&D contracts from the Navy for the design, development, and construction of *Seawolf*-class and new *Virginia*-class (NSSN Program) nuclear attack submarines. In addition, United Technologies Corp. (\$49 million), Analysis & Technology, Inc. (\$37 million), Hughes Danbury Optical Systems, Inc. (\$10 million), and Sonalysts, Inc. (\$6 million), received large R&D contracts from federal agencies in FY 1998. Yale University (\$1 million) and UConn (\$250,000) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$28 million of federal R&D dollars was also received in FY 1998 by entities located in Connecticut in the form of cooperative agreements. By far, the largest of these agreements (\$13 million in FY 1998) came from DOE to Energy Research Corp. in Danbury for work on design improvement of molten carbonate fuel cells. Other federal agencies awarding cooperative agreements to Connecticut-based entities include DOD and DOC.

Chapter 8

Federal Research and Development in Delaware

- Approximately \$60 million of federal R&D funds are spent each year in Delaware.
- Delaware ranks 47th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 5 percent of all federal funds spent in Delaware each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

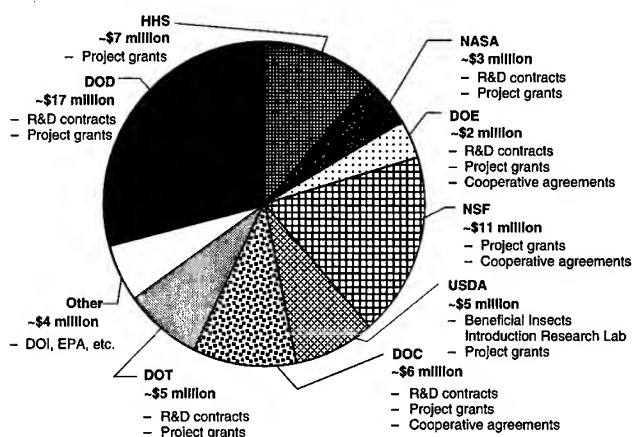


Figure 8.1 – Sources of Federal R&D Dollars Spent in Delaware
(Total Federal R&D ~\$60 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$60 million annually in Delaware on research and development (R&D) activities. On average, federal R&D dollars account for approximately 5 percent of all federal funds spent in Delaware each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Delaware. Foremost among these agencies are the Department of Defense (DOD) and the National Science Foundation (NSF), which account for 29 and 18 percent of all federal R&D dollars spent in the state, respectively. The Department of Health and Human Services (HHS) and the Department of Commerce (DOC) account for an additional 11 percent each of all federal R&D dollars spent in Delaware. The Department of Agriculture (USDA) and the Department of Transportation (DOT) each account for an additional 8 percent, while the remaining federal R&D dollars come collectively from the Department of Energy (DOE), the Department of Interior (DOI), the Environmental Protection Agency (EPA), and several other federal agencies.⁸

All federal R&D dollars spent in Delaware either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Delaware.

FEDERAL R&D UNITS IN DELAWARE

Dover, Delaware, is home to DOI's Delaware District Office of Water Resources.

- The Delaware District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D ac-

⁸ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

tivities of USGS's National Water-Quality Assessment (NAWQA) and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$75,000 in federal R&D funds.

Newark, Delaware, is home to USDA's Beneficial Insects Introduction Research Laboratory.

- The Beneficial Insects Introduction Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of the University of Delaware. It conducts research on exotic natural enemies (parasites and predators) of insect pests using classical biological approaches. Specific research activities of this laboratory focus on investigating, modeling, and predicting the interactions of pest and beneficial species. An example of the research done at this site include studies of the alfalfa weevil, once considered the primary pest of alfalfa in the United States, which is now controlled by several introduced parasites in the 13 New England and Middle Atlantic states. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about 14 FTEs.

FEDERAL R&D GRANTS TO DELAWARE ENTITIES

Every major institution of higher education in Delaware is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by NSF, HHS, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Delaware and Delaware State University (DSU). The table below shows the number of R&D grants active in FY 1998, highlighting those

made by NSF, HHS, and DOD to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to University of Delaware are ones from USDA (\$2 million), EPA (\$2 million), and \$1 million each from DOC, NASA, and DOE. Nearly all of the comparable grants going to DSU are from USDA.

Table 8.1 – Sources of Federal R&D Grants to Higher Education in Delaware

Institution	NSF		HHS		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Delaware	\$9M	152	\$6M	35	\$3M	29	\$7M	115	\$25M	331
DSU	<\$1M	1	<\$1M	4	\$1M	12	\$1M	13	\$2M	30
Other	0	0	0	0	0	0	<\$1M	1	<\$1M	1
Total	\$9M	153	\$6M	39	\$4M	41	\$8M	129	\$27M	362

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Delaware also receive a significant amount of federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are Bartol Research Institute in Newark (\$3 million) and Wilmington Medical Center (\$500,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Delaware received nine SBIR awards totaling close to \$1 million. Examples include an award for \$225,000 from EPA to Compact

Membrane Systems, Inc., in Wilmington for work on reducing NOx/hydrocarbon emissions via oxygen enriched lean burn engines and an award for \$70,000 from DOD (Ballistic Missile Defense Organization) to Elsicon, Inc., in Wilmington to develop an ultrahigh-speed demultiplexer for optical communications systems.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Delaware are ones valued at more than \$1.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Delaware every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN DELAWARE

Several entities in Delaware also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to DuPont (a portion of which is now a subsidiary of AlliedSignal Co.), which in FY 1998 received close to \$3 million from R&D contracts. These funds supported such efforts as the development of advanced hot gas filters for application in PFBC and IGCC power generation systems for DOE and ceramic composite components for turbine engine applications for DOD. In addition, Alloy Surfaces Co. (\$1 million), Astropower, Inc. (\$1 million), and ILC Dover, Inc. (\$1 million), received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. The University of Delaware (\$2 million) also received contracts in FY 1998 from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come

close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$2 million of federal R&D dollars was also received in FY 1998 by entities located in Delaware in the form of cooperative agreements. The largest of these cooperative agreements (\$1 million in FY 1998) came from DOE to DuPont in Newark to fund the Continuous Fiber Ceramic Composites (CFCC) program. Other federal agencies awarding cooperative agreements to Delaware-based entities include DOC and USDA.

Chapter 9

Federal Research and Development in the District of Columbia

- Approximately \$2.7 billion of federal R&D funds are spent each year in the District of Columbia.
- The District of Columbia ranks 10th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 13 percent of all federal funds spent in the District of Columbia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

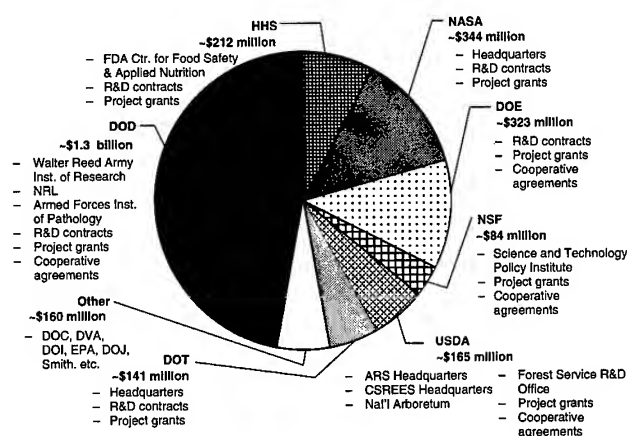


Figure 9.1 – Sources of Federal R&D Dollars Spent in the District of Columbia
(Total Federal R&D ~\$2.7 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$2.7 billion annually in the District of Columbia on research and development (R&D) activities. On average, federal R&D dollars account for approximately 13 percent of all federal funds spent in the District of Columbia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in the District of Columbia. Foremost among these agencies is the Department of Defense, which accounts for 47 percent of all federal R&D dollars received each year by the District of Columbia. The National Aeronautics and Space Administration (NASA) and the Department of Energy (DOE) account for an additional 13 and 12 percent of the federal R&D dollars spent each year in the District of Columbia, respectively. The Departments of Health and Human Services (HHS), Agriculture (USDA), and Transportation (DOT) account for an additional 8, 6, and 5 percent of all federal R&D dollars spent each year in the District of Columbia, respectively. The remaining federal R&D dollars come collectively from the National Science Foundation (NSF), the Environmental Protection Agency (EPA), and several other agencies.⁹

All federal R&D dollars spent in the District of Columbia cover the costs of operating federal R&D units in the district, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the district. The following is an overview of what becomes of these federal R&D dollars once they arrive in the District of Columbia. In reviewing the information presented below, please keep in mind that the administrative headquarters for most federal R&D programs are in the District of Columbia. With few, if any, exceptions, the dollars spent on staffing and operating these administrative units are categorized by federal agencies as federal R&D dollars. The amount of federal R&D dollars reported in this overview as being spent by various federal agen-

⁹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

cies in the District of Columbia reflects these administrative expenses. Because these administrative activities consume dollars but do not directly reflect R&D experiments or generate new knowledge, they are not showcased herein. Further, because the District of Columbia does not contain cities by which to note the more specific location of federal R&D units, the discussion in the following section is divided by federal agency.

FEDERAL R&D UNITS IN THE DISTRICT OF COLUMBIA

The District of Columbia is home to DOD's Walter Reed Army Institute of Research, Naval Research Laboratory, and Armed Forces Institute of Pathology.

- The Walter Reed Army Institute of Research is a unit of DOD. It conducts biomedical research focused on soldier health and readiness. Current research activities focus on developing drugs and vaccines to protect against infectious diseases, preventing operational stress in compact environments, and developing medical strategies to protect soldiers from chemical and biological warfare threats. This federal unit annually receives about \$64 million of federal R&D funds, almost all of which is spent on in-house activities, and has a total workforce of about 800 people, half of whom are civilians.
- The Naval Research Laboratory (NRL) is a unit of DOD. It is the Navy's corporate laboratory and the principal in-house component of the Office of Naval Research. NRL conducts a range of R&D directed toward maritime applications of new and improved materials, techniques, equipment, and systems and oceanic, atmospheric, and space sciences and related technologies. Much of the laboratory's research has focused on space, including the launch of atmospheric probes using captured V-2 rockets, the development of the nation's first satellite program, and work on the Global Positioning System. The R&D divisions of the laboratory include radar; information technology, including an Information Security Engineering Lab-

oratory and a Virtual Reality Laboratory; optical sciences; electronic warfare; the Laboratory for the Structure of Matter; chemistry; materials science and technology; the Laboratory for Computational Physics and Fluid Dynamics; the condensed matter and radiation sciences; plasma physics; electronics science and technology, which includes the Nanoelectronics Processing Facility, the Penthouse Processing Facility, and the Laboratory for Advanced Material Synthesis; the Biomolecular Science and Engineering Center; acoustics, which includes the Tactical Oceanography Simulation Laboratory; remote sensing; oceanography; marine geosciences; marine meteorology; space science; and the Naval Space Technology Center. This federal facility annually receives about \$605 million of federal R&D dollars, approximately \$304 million of which is spent on in-house activities, and has a total workforce of about 3,000 civilian personnel. In addition to its campus in the District of Columbia, the laboratory maintains research sites at the Stennis Space Center in Mississippi; Monterey, California, home to the Fleet Numerical Marine Meteorology and Oceanography Center; Lexington Park, Maryland, home to the Flight Support Detachment; Chesapeake Beach, Maryland, home to the Chesapeake Bay Detachment; Key West, Florida, home to the Marine Corrosion Test Facility; Quantico, Virginia, home to the Midway Research Center; and Mobile Bay, Alabama, home to the *USS Shadwell*, a decommissioned naval vessel.

- The Armed Forces Institute of Pathology is a unit of DOD. It conducts R&D on the etiology and pathogenesis of disease. In some cases, this research is conducted in departments that deal with pathology related to a single organ system, such as the skin, genitourinary, and female reproductive systems. In other cases, this research is conducted in departments encompassing such disciplines as infectious and parasitic diseases, veterinary pathology, and medical and molecular genetics. Through the American Registry of Pathology, a nonprofit organization created by Congress in 1976, civilian pathologists can consult the pathol-

ogists on staff at the institute. This federal unit annually receives approximately \$54 million in federal R&D funds and has about 275 civilian personnel. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

The District of Columbia is home to the headquarters of the National Aeronautics and Space Administration (NASA).

- The headquarters of NASA is responsible for managing the space flight centers, research centers, and other installations that constitute NASA. Through the coordination of three divisions—Agency Management, Functional Offices, and Enterprise Management, NASA headquarters integrates the many parts of the agency. The Agency Management division focuses on accountability and communications and functions as a liaison between NASA and its many customers; the Functional Offices serve in an advisory capacity to the NASA Administrator and work in partnership with the enterprise administrators and center directors to ensure that agency activities are being conducted in accordance with all statutory and regulatory requirements, including fiduciary responsibilities; and the Enterprise Management division is responsible for establishing overall customer requirements and ensuring customer satisfaction. This federal unit annually receives a total of approximately \$363 million, at least \$162 million of which directly involves R&D activities, and has about 974 FTEs, only a portion of whom are directly involved in R&D activities. The vast majority of NASA's R&D funds are distributed to its centers located elsewhere in the nation, much of which is then dispersed throughout the nation as grants and/or contracts.

The District of Columbia is home to the Department of Commerce's (DOC) National Systematics Laboratory.

- The National Systematics Laboratory is a unit of the Northeast Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). The laboratory maintains and revises existing names and descriptions of fish, squids, crus-

taceans, and corals of economic or ecological importance to the United States. It also names and describes new species of these organisms. Because some important species of fish, squids, and crustaceans are highly mobile and other exotic species are introduced into U.S. waters or markets, the laboratory's research is worldwide. This federal unit annually receives approximately \$53,000 of federal R&D dollars and has about six FTEs, only a portion of whom are involved in R&D activities.

The District of Columbia is home to HHS's Center for Food Safety and Applied Nutrition.

- The Center for Food Safety and Applied Nutrition is a unit of HHS's Food and Drug Administration. The center promotes and protects the public health and economic interest by ensuring that food is safe, nutritious, and wholesome; cosmetics are safe; and food and cosmetics are honestly, accurately, and informatively labeled. It conducts research in such areas as genetically engineered foods, packing materials, food adulteration, and food additives. The center also houses the hazard analysis critical control point food safety system that focuses on preventing problems rather than reacting to them after they have occurred. This federal unit annually receives approximately \$12.4 million of federal R&D funds and has about 181 FTEs directly involved in R&D activities.

The District of Columbia is home to USDA's Forest Service Research and Development Office; the headquarters of the Agricultural Research Service; Cooperative Research, Extension, and Education Service Headquarters; and the U.S. National Arboretum.

- The Forest Service Research and Development Office is responsible for coordinating national research programs and providing expert scientific advice to the Forest Service's R&D units through review and analysis of experiment station programs. In addition to performing administrative duties, the office covers R&D projects with national scope that require special emphasis

and R&D activities that may get supplemental funding for only one fiscal year. Such projects include the Urban Treehouse Program aimed at inner-city and metropolitan areas; the International Arid Lands Consortium designed to reclaim semiarid lands in the United States, Israel, and elsewhere in the world; and the Patents Program to protect the federal government's interest in new technologies. This federal unit annually receives approximately \$16.4 million of federal R&D funds and has about 54 employees.

- The Agricultural Research Service (ARS) Headquarters unit is responsible for planning, implementing, coordinating, and assessing the national programs of ARS. National staff is in charge of identifying high-priority research issues and bringing all the relevant parties together to develop the best method of addressing a research priority. These activities are separated according to whether they involve animal production, natural resources, or crop production. The planning and coordination responsibilities within each of these areas are further divided to better focus on the complementary research capabilities and needs within a particular field, such as food safety, animal health, air quality, manure and byproduct utilization, crop production, and plant diseases. This federal R&D unit annually receives approximately \$44.5 million in federal R&D dollars to cover headquarters activities and has about 463 employees. The vast majority of the service's R&D funds are dispersed to the hundreds of agricultural research centers throughout the nation.
- The Cooperative State Research, Extension, and Education Service (CSREES) Headquarters is responsible for the management and oversight of the extramural scientific research and education programs of the USDA. Specifically, the headquarters unit coordinates USDA's partnerships with the land-grant university system, other colleges and universities, and other public and private research and education organizations in the initiation and development of agricultural research, extension, and

higher education programs that are carried out by land-grant universities and other partners. It works with land-grant institutions in each state, territory, and the District of Columbia; more than 130 colleges of agriculture; 59 agricultural experimental stations; 57 cooperative extension services; and 63 forestry schools. Additionally, the headquarters unit is responsible for strategic planning to improve agricultural productivity, create new products, protect animal and human health, and revitalize rural American communities. This federal unit annually receives approximately \$14 million in federal R&D dollars to cover the cost of headquarter activities and has about 190 FTEs, most of whom are directly involved in R&D activities. The vast majority of the service's federal R&D funds are dispersed throughout the nation as grants and/or contracts.

- The U.S. National Arboretum, a unit of USDA's ARS, is composed of three research divisions—the Floral and Nursery Plants Research Unit, the Education and Visitors Services Unit, and the Gardens Unit. The Arboretum conducts research to conserve and display trees, shrubs, flowers, and other plants to enhance the environment. Specific research activities at the Arboretum include plant breeding and taxonomy, with an emphasis on tree and shrub breeding and taxonomy. Research in this area has resulted in the introduction of pest- and disease-resistant *Ulmus* and *Acer* as well as new forms of the magnolia. This federal R&D unit annually receives approximately \$7.1 million of federal R&D funds and has about 96 FTEs.

The District of Columbia is home to parts of the EPA's National Center for Environmental Assessment and its National Center for Environmental Research and Quality Assurance.

- The National Center for Environmental Assessment is a unit of the EPA. While it is headquartered in the District of Columbia, the center maintains offices in Cincinnati, Ohio, and Research Triangle Park, North Carolina. This office, which focuses on characterizing the risk resulting from exposure to various haz-

ards, conducts research on human and ecological risk assessment paradigms. Recent R&D activities include biologically based modeling using pharmacokinetic and mechanistic information. This federal R&D office annually receives approximately \$16.2 million of federal R&D funds, only a fraction of which is spent in the District of Columbia. The vast majority of these R&D dollars are dispersed throughout the nation as grants.

- The National Center for Environmental Research and Quality Assurance is a unit of the EPA. It manages the EPA's research grant and fellowship programs. These programs are designed to expand the EPA's science and technology base and the pool of qualified environmental professionals. The center also serves as EPA's focal point for issues on quality assurance and peer review. This federal R&D unit has about 78 FTEs and annually receives approximately \$147.8 million of federal R&D funds, the vast majority of which is transferred to external parties to support the conduct of extramural R&D projects and experiments.

The District of Columbia is home to NSF's Science and Technology Policy Institute.

- The Science and Technology Policy Institute, formerly the Critical Technologies Institute, is a federally funded research and development center (FFRDC) sponsored by NSF and operated by RAND. It is headquartered in Washington, D.C., but conducts approximately 20 percent of its activities in California. The institute conducts studies and policy analyses for the White House Office of Science and Technology Policy, the cabinet-level National Science and Technology Council, NSF, and other government agencies concerned with policies affecting science and technology. Specific research projects have focused on determining the impact of technology innovation on society, estimating the costs of reducing greenhouse gas emissions, and analyzing the effectiveness of alternative public-private partnerships with the commercial remote sensing industry. This

federally owned and contractor-operated R&D unit annually receives approximately \$2.5 million of federal funds and employs about 15 people. While the funds received by this unit are credited to California where the headquarters of RAND is located, it has no impact on the geographic allocation of federal R&D dollars, because none of the activities of the institute is considered by NSF to be R&D. As a result, none of the institute's funds are included in the official federal R&D budget. Because the institute is a congressionally chartered federally funded *research and development* center, however, it has been included in this report.

The District of Columbia is home to the headquarters of DOT.

- The headquarters of DOT is responsible for managing and coordinating the eleven individual operating administrations that constitute DOT. These include the Bureau of Transportation Statistics, U.S. Coast Guard, the Federal Aviation Administration, the Federal Highway Administration, the Federal Railroad Administration, the Federal Transit Administration, the Maritime Administration, National Highway Traffic Safety Administration, the Research and Special Programs Administration, the Saint Lawrence Seaway Development Corporation, the Surface Transportation Board, and the Transportation Administrative Services Center. Other responsibilities include negotiating and overseeing the implementation of international transportation agreements, ensuring the fitness of U.S. airlines, enforcing airline consumer protection regulations, issuing regulations to prevent alcohol and illegal drug misuse in transportation systems, and preparing transportation legislation. This federal unit annually receives approximately \$3.5 million federal R&D dollars to cover the costs of headquarters activities and has about 20 FTEs. The vast majority of its R&D funds are distributed to DOT units around the country or are dispersed throughout the nation as grants and/or contracts.

The District of Columbia is home to the Department of Interior's (DOI) Patuxent Biological Survey Project.

- The Biological Survey Project is a unit of the Patuxent Wildlife Research Center inside DOI's USGS. The unit is located in the National Museum of Natural History. It conducts research on a wide range of scientific activities that seek to understand and address national and regional natural resource problems. It conducts inventories, identifies resource issues, and tests hypotheses through research, designing and evaluating monitoring programs. It also provides objective results to managers and citizens. Specific research activities of this unit include studies on the control and containment of the brown tree snake, the geographic variation in white-fronted geese, and a synthesis of the biology of North American amphibian larvae. This federal R&D unit annually receives approximately \$959,000 of federal R&D funds and has about 15 FTEs.

The District of Columbia is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Washington, D.C., VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 359 projects with total funding of approximately \$2 million. These R&D activities focus on a wide range of topics, including HIV/AIDS, congestive heart failure, neoplasms, and hepatitis.

The District of Columbia is home to the Department of Justice's (DOJ's) Federal Bureau of Investigation Laboratory and National Institute of Justice.

- The Federal Bureau of Investigation Laboratory is a unit of DOJ. It conducts R&D on new tools for forensic and investigative support. It is also responsible for providing forensic services to forensic medicine and law enforcement professionals. In addition to conducting R&D, the laboratory is responsible for

providing timely, high-quality examinations of physical evidence, analytical reports, expert testimony in court, operational and technical support for investigations, and training and symposia for crime laboratory practitioners and law enforcement personnel. This federal unit annually receives approximately \$5 million of federal R&D funds and employs about 1,100 people, only a fraction of whom are directly involved in R&D activities.

- The National Institute of Justice is a unit of DOJ. It is headquartered in the District of Columbia and oversees programs that support R&D on new technologies to fight crime and improve criminal justice, carries out research on criminal behavior, evaluates the effectiveness of criminal justice programs, identifies promising new programs, and develops new methods to prevent crime and reduce delinquency. This federal unit annually receives approximately \$6 million of federal R&D funds to cover headquarters activity and has about 70 FTEs. The vast majority of its R&D funds are dispersed throughout the nation as grants and contracts.

The District of Columbia is home to the R&D units of most Smithsonian Institution museums and centers.

- The National Museum of Natural History conducts research on topics of current societal importance, such as terrestrial and marine biological diversity, global climate change, genetic research, and ecosystem modeling. The museum annually receives approximately \$17.5 million of federal R&D funds and employs about 582 people, only a portion of whom are involved in R&D activities.
- The National Air and Space Museum conducts research on the evolution of air and space technology. With the largest collection of aviation and space artifacts in the world, the National Air and Space Museum collects and preserves objects that tell the entire history of aviation and space flight. The museum annually receives approximately \$3 million of federal R&D funds and has a workforce of about 214 employees, only a portion of whom are involved in R&D activities.

- The National Museum of American History conducts research on the cultural, scientific, and technological growth of the United States. The museum annually receives approximately \$5 million of federal R&D funds and employs about 304 people, only a portion of whom are involved in R&D activities.
- The National Museum of American Art conducts research on American paintings, sculptures, graphics, folk art, and photographs. The museum annually receives approximately \$2 million of federal R&D funds and employs about 123 people, only a portion of whom are involved in R&D activities.
- The National Portrait Gallery conducts research on U.S. history as revealed through paintings, sculptures, prints, drawings, and photographs of the men and women who made significant contributions to its development. The museum annually receives approximately \$1.3 million of federal R&D funds and employs about 85 people, only a portion of whom are involved in R&D activities.
- The National Postal Museum conducts research on postal history and the preservation of philatelic items. The museum annually receives approximately \$120,000 of federal R&D funds and employs about nine people, only a few of whom are directly involved in R&D activities.
- The Hirshhorn Museum and Sculpture Garden conducts research on modern art. The museum annually receives approximately \$500,000 of federal R&D funds and employs about 71 people, only a fraction of whom are involved in R&D activities.
- The Arthur M. Sackler Gallery and the Freer Gallery of Art conduct research on the art of Asia. The galleries annually receive approximately \$1.3 million of federal R&D funds and employ about 77 people, only a portion of whom are involved in R&D activities.
- The National Museum of African Art conducts research on the traditional and contemporary arts of Africa, especially those

from south of the Sahara. The museum annually receives approximately \$600,000 of federal R&D funds and employs about 54 people, only a portion of whom are involved in R&D activities.

- The Anacostia Museum and Center for African American History and Culture conducts research on the African-American experience, as well as contemporary urban issues (e.g., housing, transportation, and health care) and their impact on the African-American community. The museum annually receives approximately \$400,000 of federal R&D funds and employs about 25 people, only a portion of whom are involved in R&D activities.
- The Archives of American Art conducts research on the visual arts in America using primary source documentation. The archive annually receives approximately \$830,000 of federal R&D funds and employs about 24 people, about half of whom are involved in R&D activities. In addition to its research center in the District of Columbia, the archive has research centers in New York and California, only one of which (in California) actually conducts research on-site.
- The Center for Folklife Programs and Cultural Studies conducts research on the expressive cultures of ethnic, regional, tribal, and occupational groups and the contexts in which they occur. The center annually receives approximately \$200,000 of federal R&D funds and employs about 14 people, a few of whom are involved directly in R&D activities.
- The Smithsonian Institution Archives conducts research on the history of the Smithsonian Institution. The archive annually receives approximately \$1 million of federal R&D funds and employs about 24 people, the majority of whom are involved in R&D activities.
- The Smithsonian Institution Libraries conduct research focused on the Smithsonian's collection of 1.2 million books, most especially its 40,000 rare volumes. The libraries annually receive

approximately \$5.5 million of federal R&D funds and employ about 107 people, the vast majority of whom are involved in R&D activities.

FEDERAL R&D GRANTS TO DISTRICT OF COLUMBIA ENTITIES

Every major institution of higher education in the District of Columbia is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, DOD, and NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as Georgetown University, George Washington University (GWU), Howard University, Catholic University of America (CUA), the University of the District of Columbia (UDC), and American University. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, DOD, and NSF to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Nearly all of the grants in the "Other Agencies" category going to Georgetown University are from

Table 9.1 – Sources of Federal R&D Grants to Higher Education in the District of Columbia

Institution	HHS		DOD		NSF		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Georgetown	\$45M	234	\$10M	15	\$1M	23	\$4M	8	\$60M	280
GWU	\$21M	53	\$2M	12	\$1M	26	\$2M	24	\$26M	115
Howard	\$11M	31	\$3M	19	\$1M	17	\$2M	34	\$16M	101
CUA	\$1M	10	\$1M	7	\$1M	21	\$2M	36	\$5M	74
UDC	\$1M	5	<\$1M	2	<\$1M	2	\$1M	11	\$3M	20
American	<\$1M	3	<\$1M	1	\$1M	10	<\$1M	10	\$1M	24
Other	<\$1M	4	0	0	<\$1M	3	\$1M	15	\$2M	22
Total	\$79M	340	\$16M	56	\$5M	102	\$13M	138	\$112M	636

the Department of Transportation (\$4 million). DOE provides close to \$1 million of the comparable grants going to both GWU and Howard University. The grants going to CUA in this category include \$1 million each from NASA and the Department of Education. UDC similarly receives about \$1 million each from NASA and USDA.

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds often account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in the District of Columbia also received a significant amount of federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are the National Academy of Sciences (\$30 million), the Carnegie Institution (\$7 million), and the Medlantic Research Foundation (\$5 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in the District of Columbia received nine SBIR awards totaling \$1 million. Examples include a \$250,000 award from the Department of Education to A.U. Software, Inc., in Washington for work on promoting student self-determination and a \$100,000 award from HHS to Healthmark Associates in Washington to develop an interactive prostate cancer decision support system.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting the District of Columbia are ones valued at more than \$530,000 from USDA's CSREES for the support of research in agriculture.

OTHER FEDERAL R&D ACTIVITIES IN THE DISTRICT OF COLUMBIA

Several entities in the District of Columbia also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from NSF to the Joint Oceanographic Institutions, which in FY 1998 received close to \$49 million from a continuing R&D contract to manage and operate the Ocean Drilling Program. In addition, the National Academy of Sciences (\$23 million), the American Registry of Pathology (\$11 million), Advanced Power Technologies (\$10 million), the American Institutes for Research (\$10 million), and Lockheed Martin (\$9 million) received very large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by the National Academy of Sciences. Georgetown University (\$10 million), GWU (\$9 million), and Howard University (\$3 million) also received contracts in FY 1998 from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$20 million of federal R&D dollars was also received in FY 1998 by entities in the District of Columbia in the form of cooperative agreements. One of the largest of these cooperative agreements (\$3 million in FY 1998) came from DOE to the National Academy of Sciences for reviews and studies in the field of radioactive waste management. Other federal agencies awarding cooperative agreements to the District of Columbia-based entities include NSF, DOJ, and DOD.

Chapter 10

Federal Research and Development in Florida

- Approximately \$3.2 billion of federal R&D funds are spent each year in Florida.
- Florida ranks 7th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 13 percent of all federal funds spent in Florida each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

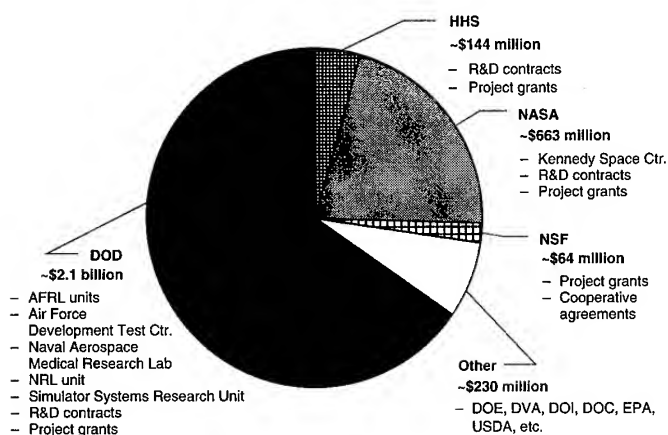


Figure 10.1 – Sources of Federal R&D Dollars Spent in Florida
(Total Federal R&D ~\$3.2 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$3.2 billion annually in Florida on research and development (R&D) activities. On average, federal R&D dollars account for approximately 13 percent of all federal funds spent in Florida each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Florida. Foremost among these agencies is the Department of Defense (DOD), which accounts for 65 percent of all federal R&D dollars spent in the state. The National Aeronautics and Space Administration (NASA) and the Department of Health and Human Services (HHS) account for an additional 21 and 5 percent of the federal R&D dollars spent in Florida, respectively. The remaining federal R&D dollars come collectively from the National Science Foundation (NSF), the Department of Agriculture (USDA), the Department of Energy (DOE), the Department of Commerce (DOC), and several other federal agencies.¹⁰

All federal R&D dollars spent in Florida either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Florida.

FEDERAL R&D UNITS IN FLORIDA

Brooksville, Florida, is home to USDA's Subtropical Agricultural Research Station.

- The Subtropical Agricultural Research Station is a unit of USDA's Agricultural Research Service (ARS). It conducts research on the factors that affect forage production and utilization by livestock, the responses of different biological types of

¹⁰ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

cattle to a range of nutrient and location variables, and the physiological bases of these response differences. Specific research activities include characterization and evaluation of tropically adapted breeds of cattle. This federal R&D unit annually receives approximately \$800,000 of federal R&D funds and has about 10 FTEs.

Canal Point, Florida, is home to USDA's U.S. Sugarcane Field Station.

- The U.S. Sugarcane Field Station is a unit of USDA's ARS. It conducts research on sugarcane crossing and variety and the entomological and pathological pests of sugarcane. Specific research activities of this laboratory focus on determining the best-yielding varieties of sugarcane under South Florida conditions. To retain sugarcane profitably while supporting this ecosystem, the laboratory concentrates on developing sugarcane varieties that reduce phosphorus in the water and that tolerate higher water tables. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about 23 FTEs.

Cape Canaveral, Florida, is home to NASA's Kennedy Space Center.

- The John F. Kennedy Space Center is a unit of NASA. It conducts research programs to improve the launch and operation of space systems. The center's R&D activities focus on the development of reusable launch vehicles, the physiological effects of microgravity, and the design of the International Space Station. Specific areas of investigation include industrial engineering, environmental technology, advanced software, nondestructive evaluation, electronics and instrumentation, life sciences, automation and robotics, and materials science. The center also conducts R&D on ground support systems, launch and processing facilities, and environmental protection. This federal facility annually receives a total of about \$797 million, at least \$246 million of which directly involves R&D efforts. The center has about 1,869 FTEs, only a portion of whom are involved in R&D activities. A substantial portion of its funds is spent on

the maintenance and operation of R&D equipment and facilities. In a recent year, the center awarded over \$4 million of R&D contracts, about \$1 million of which were made to entities based in Florida.

Fort Lauderdale, Florida, is home to USDA's Aquatic Weed Control Research Laboratory.

- The Aquatic Weed Control Research Laboratory is a unit of USDA's ARS on the campus of the University of Florida at Fort Lauderdale. It conducts research on sustainable aquatic and wetland weed control methods based on biological and integrated technologies. Specific research activities of this laboratory are aimed at permanently reducing the impact of invasive, nonnative aquatic, and wetland weeds in natural and agroecosystems. This federal R&D unit annually receives approximately \$1 million of federal R&D funds and has about 10 FTEs.

Gainesville, Florida, is home to USDA's Center for Medical, Agricultural, and Veterinary Entomology and Crop Genetic and Environmental Research Unit, the Department of Interior's (DOI) Florida Caribbean Science Center and a Cooperative Fish and Wildlife Research Unit, and a Department of Veterans Affairs (DVA) R&D unit.

- The Center for Medical, Agricultural, and Veterinary Entomology is a unit of USDA's ARS located on the campus of the University of Florida at Gainesville. It consists of six research divisions focusing on modeling and bioengineering, insect behaviors and biocontrol, imported fire ant and household insects, mosquitoes and flies, postharvest and bioregulation, and chemistry. The center conducts research on insects of agricultural, medical, and veterinary importance to control pest species through the development of environmentally acceptable approaches. Research activities focus on the impact of insects on agricultural production, postharvest storage and transport of agricultural commodities, and protection from household and disease-carrying arthropods. This federal R&D unit, together with the

Crop Genetic and Environmental Research Laboratory described below, annually receives approximately \$10.1 million of federal R&D funds and has about 141 FTEs.

- The Crop Genetic and Environmental Research Laboratory is a unit of USDA's ARS located on the campus of the University of Florida at Gainesville. It conducts research on crop and forage plants to determine the role of genetic, metabolic, and environmental factors in limiting productivity. Specific research activities of this laboratory include developing strategies to maximize plant performance under a wide range of growth conditions that can be applied to a number of crop species. The funding and staffing information for this federal R&D unit are included in those presented immediately above for the Center for Medical, Agricultural, and Veterinary Entomology.
- The Florida Caribbean Science Center is a unit of DOI's U.S. Geological Survey (USGS). It conducts research on coastal and marine ecology, restoration ecology, invasive species, and biological diversity. Specific research activities of this center include researching wetlands and their component fish and wildlife resources with an emphasis on their linkages with both aquatic and terrestrial ecosystems; analyzing data on the distribution, biology, and environmental effects of nonnative aquatic species introduced into the environment; and researching endocrine disruption and the role of environmental contaminants. The center has three other field stations in Florida—the Big Cypress Field Station, the Everglades Field station, and the South Florida Field Station. These federal R&D units combined annually receive approximately \$2.9 million of federal R&D funds and have about 59 FTEs.
- The Florida Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the Gainesville campus of the University of Florida. It conducts research on fish and wildlife ecology. Specific research activities of this unit include developing modeling approaches and empirical studies to support the

Across-Trophic-Level System Simulation for the Everglades and studying the movements, spatial use patterns, and habitat utilization of radio-tagged West Indian Manatees along the Atlantic coast of Florida and Georgia. This federal R&D unit annually receives approximately \$240,000 of federal R&D funds and has about four FTEs.

- While the principal focus of the Gainesville Division of the North Florida/South Georgia Veterans Healthcare System facility, the VA Medical Center in Gainesville, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 351 projects with total funding of approximately \$1 million. These R&D activities focus on a wide range of topics, including magnetic resonance imaging, coronary disease, drug therapy, and epilepsy.

Gulf Breeze, Florida, is home to the Environmental Protection Agency's (EPA) Gulf Ecology Division.

- The Gulf Ecology Division is a unit of EPA's National Health and Environmental Effects Research Laboratory headquartered in Research Triangle Park, North Carolina. It conducts research on the effects of human activities on bays, estuaries, and wetlands of the Gulf of Mexico, southeastern Atlantic Coast, Puerto Rico, and the U.S. Virgin Islands. Specifically, the division conducts research to understand the physical, chemical, and biological dynamics of coastal wetlands and estuaries; determine ecological condition; evaluate rates and causes of declining ecological systems; and predict future conditions under various alternative water quality scenarios, including estuarine assessment and remediation. This federal R&D unit annually receives approximately \$9 million of federal R&D funds and has about 71 FTEs. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Key West, Florida, is home to DOD's Naval Research Laboratory Marine Corrosion Test Facility.

- The Marine Corrosion Test Facility is a unit of DOD's Naval Research Laboratory. It conduct R&D on weathering, general corrosion, fouling, electrochemical phenomena, coatings, cathode protection devices, and other forms of environmental degradation. The funding and staffing figures for this facility are modest and are included in those for the main laboratory in the District of Columbia.

Key Largo and Marathon, Florida, are home to DOC's Florida Keys National Marine Sanctuary.

- The Florida Keys National Marine Sanctuary is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). Such sanctuaries conduct research on the marine environment to identify areas of special national significance due to their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific research activities of this unit include studying coral ecology, coral reef geology, invertebrate and macroalgal ecology, water quality, and fish diseases. Together, the two portions of this federal unit annually receive approximately \$497,000 of federal R&D funds and have about 11 FTEs.

Miami, Florida, is home to USDA's Subtropical Horticultural Research Laboratory; the DOC's Atlantic Oceanographic and Meteorological Laboratory and Miami Laboratory; and a DVA R&D unit.

- The Subtropical Horticultural Research Laboratory is a unit of USDA's ARS. It conducts research on tropical and subtropical crops through the introduction, preservation, evaluation, and distribution of plant germplasm. Specific research activities of this laboratory include the development of methods to manage insect and disease pests and agricultural hydrology. This federal R&D unit annually receives approximately \$2.3 million of federal R&D funds and has about 28 FTEs.
- The Atlantic Oceanographic and Meteorological Laboratory is a unit of DOC's NOAA. It conducts research on oceanography,

tropical meteorology, atmospheric and oceanic chemistry, and acoustics. The specific focus of the laboratory is to obtain the knowledge that will ultimately lead to improved prediction and forecasting of severe storms, better utilization and management of marine resources, better understanding of the factors affecting both climate and environmental quality, and improved ocean and weather services for the nation. Current research activities include studies of ocean heat transport and storage, surface currents, the role of tropospheric dimethyl sulfide in forming cloud condensation nuclei, hurricane analysis and prediction, and the measurement of sea level and meteorological variables. This federal unit annually receives approximately \$10.8 million of federal R&D funds and has about 108 FTEs.

- The Miami Laboratory is the headquarters of the Southeast Fisheries Science Center inside DOC's NOAA. The overall center consists of several laboratories that conduct research to conserve and manage fishery resources, marine mammals, and sea turtles. The three laboratories in Miami focus on oceanic pelagic resources, coastal resources, and migratory fishery biology. Specifically, they conduct research to support the management of the marine fishery resources, most especially reef fish and coastal pelagic species, of the U.S. South Atlantic and the Gulf of Mexico. Current research activities focus on oceanic pelagic stocks, Atlantic bluefin tuna, deep-water marine mammals in the Gulf of Mexico, bottlenosed dolphins, and sharks. This federal unit annually receives approximately \$8.9 million of federal R&D funds and has about 100 FTEs, only a portion of whom are involved in R&D activities.
- While the principal focus of the Miami VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 263 projects with total funding of approximately \$3 million. These R&D activities focus on a wide range of topics, including osteoarthritis, HIV/AIDS, neoplasms, and aging.

Niceville, Florida, is home to DOD's Air Force Development Test Center and Air Force Research Laboratory Munitions Directorate.

- The Air Force Development Test Center at Eglin Air Force Base is a unit of DOD. It provides a national capability for testing and evaluating weapons. Specifically, the center tests and evaluates USAF conventional weapons, countermeasures, and command and control systems. In addition, it tests weapon systems under extreme environmental conditions, provides test support for precision-guided weapons in simulated "real world" environments, and installs systems testing of air-to-air and air-to-surface munitions and electronics systems on full-scale aircraft and land vehicles. This federal unit annually receives about \$536 million of federal R&D funds, approximately \$260 million of which are spent on in-house activities, and employs about 2,555 civilians, only a portion of whom are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Munitions Directorate at Eglin Air Force Base is a unit of DOD's Air Force Research Laboratory. It develops conventional air-delivered munitions. Current R&D activities focus on ordnance technologies, such as warheads, fuzes, and explosives; advanced guidance for munitions, using simulation and image and signal processing; navigation and control technologies; and computational mechanics, lethality and vulnerability assessments, and flight vehicle integration. This federal unit annually receives about \$65 million of federal R&D funds, approximately \$14 million of which are spent on in-house activities, and has about 255 civilian personnel, only about 55 percent of whom are involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Orlando, Florida, is home to DOD's Simulator Systems Research Unit and USDA's U.S. Horticultural Research Laboratory.

- The Simulator Systems Research Unit is part of DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are located in Fort Rucker, Alabama; Fort Benning, Georgia; Fort Knox, Kentucky; Fort Leavenworth, Kansas; Fort Bragg, North Carolina; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. The unit conducts R&D on training requirements for advanced training systems, devices, and simulators. Specific research activities also include assisting Simulation, Training, and Instrumentation Command (STRICOM) in simulation technology base activities, training device definition, and evaluating training equipment concepts. This federal R&D unit annually receives approximately \$1.8 million in federal R&D funds, only a portion of which is spent on in-house R&D activities, and has about nine civilian personnel directly involved in R&D activities.
- The U.S. Horticultural Research Laboratory is a unit of USDA's ARS. It is composed of four research divisions focusing on horticulture and breeding, subtropical insects, export and quality improvements, and subtropical plant pathology. The laboratory conducts R&D on insect pests of citrus and other subtropical fruits and vegetables. Specific research activities include studies of postharvest problems of horticultural crops; plant varieties with enhanced tolerances of environmental stress, and resistance to diseases and pests; bacterial, fungal, nematode, and viral diseases of subtropical crops; environmental stresses that cause losses in crop growth, survival, and production; and methyl bromide fumigation alternatives. This federal R&D unit annually receives approximately \$6.3 million of federal R&D funds and has about 72 FTEs.

Panama City, Florida, is home to portions of DOD's Air Force Research Laboratory Materials and Manufacturing Directorate and its Air Force Research Laboratory Air Vehicles Directorate.

- The Materials and Manufacturing Directorate at Tyndall Air Force Base is a unit of DOD's Air Force Research Laboratory.

The directorate is headquartered in Dayton, Ohio. This unit conducts R&D on thermal protection materials, metallic and nonmetallic structural materials, nondestructive inspection methods, materials used in aerospace propulsion systems, electromagnetic and electronic materials, laser hardened materials, materials process design techniques, environmental protection technologies, and airbase infrastructures. This federal unit annually receives approximately \$6 million of federal R&D funds and has about 24 civilian personnel, only a portion of whom are involved in R&D activities.

- The Air Vehicles Directorate at Tyndall Air Force Base is a unit of the Air Force Research Laboratory. The directorate is headquartered in Dayton, Ohio. This unit conducts R&D on aeronautical sciences, flight systems and operations, and structure. Specific research activities of this unit include developing and demonstrating innovations in vehicle technology from subsonic through hypersonic flight, developing and demonstrating advanced flight control concepts, and developing better ways to integrate multidisciplinary functional areas, such as aeromechanics, structures, flight control, crew systems, subsystems, propulsion, avionics, and weapons, to maximize the payoff of the technologies on overall system performance and affordability. This federal unit annually receives approximately \$2 million of federal R&D funds, only about half of which is spent of in-house R&D activities, and employs about three people.

Pensacola, Florida, is home to DOD's Naval Aerospace Medical Research Laboratory.

- The Naval Aerospace Medical Research Laboratory is a unit of DOD. It conducts R&D on aviation medicine and related sciences to enhance the health, safety, and readiness of Navy and Marine Corps personnel. Specific research areas of interest include spatial orientation, human performance, aeromedical standards, aviation medicine, operational medicine, environmental physiology, aviation selection, bioengineering, acceleration, aviation performance, and sensory sciences. R&D facilities

include acoustical, visual, vestibular, cognitive, psychopharmacological, and thermal-stress laboratories; three operational mobile field laboratories; and man-rated acceleration-research devices. This federal unit annually receives about \$2.4 million of federal R&D funds, approximately \$2.1 million of which are spent on in-house activities, and has about 25 civilian personnel.

St. Petersburg, Florida, is home to DOI's Center for Coastal Geology and Regional Marine Studies.

- The Center for Coastal Geology and Regional Marine Studies is a unit of DOI's USGS. It conducts research on geologic processes related to societal problems arising in coastal and marine environments including natural hazards, resources, and environmental change. Specific research activities of this center include conducting coastal assessment of shoreline changes; determining the flow and rate of groundwater beneath Florida Bay, the Florida Keys, and reef tract; and conducting remote sensing of coastal ocean color for coastal oceanographic research. This federal R&D unit, which is affiliated with the Geologic Eastern Regional office in Reston, Virginia, annually receives approximately \$8.4 million of federal R&D funds and has about 80 employees.

Tallahassee, Florida, is home to DOI's Florida District Office of Water Resources.

- The Florida District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment Program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program stud-

ies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$5 million in federal R&D funds.

Winter Haven, Florida, is home to USDA's Citrus and Subtropical Products Laboratory.

- The U.S. Citrus and Subtropical Products Laboratory is a unit of USDA's ARS. It conducts research on enhancing the market characteristics of citrus and subtropical commodities. Specific research activities of this laboratory include the development and utilization of biochemical, botanical, and biotechnological techniques to control or slow ripening and early senescence of fruits and the development of new approaches for converting fruit-processing wastes into value-added products. This federal R&D unit annually receives approximately \$1.2 million of federal R&D funds and has about 18 FTEs.

Bay Pines and Tampa are home to VA Medical Centers. While the principal focus of these medical centers is providing medical care to veterans, each center is also the site of a number of research activities. In a recent year, these federally owned and operated facilities have been the sites of 337 R&D projects with total funding of about \$1.2 million. These R&D activities focus on a variety of topics, including drug therapy, wound healing, congestive heart failure, and neoplasms.

FEDERAL R&D GRANTS TO FLORIDA ENTITIES

Every major institution of higher education in Florida is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, DOD, and

NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Miami, the University of Florida, the University of South Florida (USF), Florida State University, Florida Atlantic University, Florida International University (FIU), Florida A&M University, the University of Central Florida (UCF), and Nova Southeastern University (NSU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, DOD, and NSF to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to University of Florida are ones from USDA (\$5 million), DOE (\$4 million), and NASA (\$2 million). The comparable grants going to the University of South Florida include \$2 million from the Department of Education and nearly \$1 million each from NASA and DOC. The grants going to Florida State in this category include \$3 million from both DOE and DOC and \$2 million from NASA. FIU receives \$5 million from DOE and \$2 million from NASA in this category, and Florida A&M similarly receives \$2 million from DOE and \$1 million from both NASA and USDA.

Table 10.1 – Sources of Federal R&D Grants to Higher Education in Florida

Institution	HHS		DOD		NSF		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Miami	\$66M	242	\$6M	51	\$9M	113	\$2M	38	\$83M	444
U of Florida	\$52M	283	\$6M	51	\$12M	234	\$13M	474	\$83M	1,042
USF	\$11M	85	\$15M	20	\$2M	49	\$4M	47	\$33M	201
Florida State	\$7M	45	\$1M	12	\$7M	110	\$9M	86	\$25M	253
Florida Atlantic	\$2M	13	\$9M	17	<\$1M	17	\$1M	13	\$12M	60
FIU	\$1M	3	\$1M	16	\$1M	38	\$8M	23	\$11M	80
Florida A&M	\$5M	5	<\$1M	1	<\$1M	9	\$5M	41	\$10M	56
UCF	<\$1M	2	\$1M	9	\$3M	43	\$1M	23	\$5M	77
NSU	\$1M	4	<\$1M	1	<\$1M	9	<\$1M	3	\$2M	17
Other	\$3M	14	\$2M	7	\$1M	26	\$1M	24	\$7M	71
Total	\$148M	696	\$42M	185	\$37M	648	\$44M	772	\$271M	2,301

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Rosenstiel School of Marine and Atmospheric Science at the University of Miami.

Several other nonacademic institutions in Florida also receive a significant amount of federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are Blue Cross/Blue Shield in Jacksonville Beach (\$6 million), Harbor Branch Oceanographic Institution in Fort Pierce (\$2 million), Mount Sinai Medical Center in Miami Beach (\$2 million), and the Florida Department of Education in Tallahassee (\$2 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Florida received 83 SBIR awards totaling \$18 million. Examples include a \$600,000 award from NASA to Afab Technologies, Inc., in Loxahatchee for work on a low-cost self-acting liquid hydrogen boil-off recovery system and a \$400,000 award from NSF to McAlindon Enterprises, Inc., in Orlando to develop an alternative keyboard for typists with carpal tunnel syndrome.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Florida are ones valued at more than \$4.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research In-

stitute in Florida every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN FLORIDA

Several entities in Florida also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to United Technologies Corporation (UTC), which in FY 1998 received close to \$583 million in R&D contracts. Nearly all of these awards were from DOD (Navy) to UTC's Pratt & Whitney division in support of the Joint Strike Fighter (JSF) Engine Ground and Flight Demonstration Program. In addition, Lockheed Martin (\$93 million), Primex Technologies (\$77 million), Northrop Grumman (\$71 million), and Coleman Research Corp. (\$57 million) received very large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. For example, Lockheed Martin received close to \$1 million in R&D grants in FY 1998. Also, the University of Miami, the University of Florida, and the University of Central Florida each received nearly \$7 million in contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$68 million of federal R&D dollars was also received in FY 1998 by entities located in Florida in the form of cooperative agreements. The largest of these cooperative agreements (\$18 million in FY 1998) came from NSF to Florida State University in Tallahassee for its administration of the National High Magnetic Field Laboratory. Another of these cooperative agreements (\$6.4 million in FY 1998) came from DOC to the University of Miami's Rosenstiel School of Marine and Atmospheric Sciences to operate the Cooperative Institute for Marine and Atmospheric Studies. Other federal agencies awarding cooperative agreements to Florida-based entities include DOE, USDA, and DOD.

Chapter 11

Federal Research and Development in Georgia

- Approximately \$4.4 billion of federal R&D funds are spent each year in Georgia.
- Georgia ranks 4th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 26 percent of all federal funds spent in Georgia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

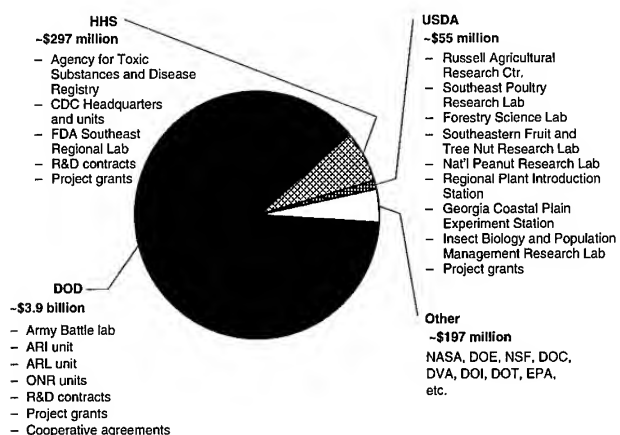


Figure 11.1 – Sources of Federal R&D Dollars Spent in Georgia
(Total Federal R&D ~\$4.4 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$4.4 billion annually in Georgia on research and development (R&D) activities. On average, federal R&D dollars account for approximately 26 percent of all federal funds spent in Georgia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Georgia. Foremost among these agencies is the Department of Defense (DOD), which accounts for 88 percent of all federal R&D dollars spent in Georgia each year. The Department for Health and Human Services (HHS) accounts for an additional 7 percent, with the remainder coming collectively from the Department of Agriculture (USDA), National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), the Environmental Protection Agency (EPA), the Department of Energy (DOE), and other agencies.¹¹

All federal R&D dollars spent in Georgia either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Georgia.

FEDERAL R&D UNITS IN GEORGIA

Athens, Georgia, is home to USDA's Richard B. Russell Agricultural Research Center, Southeast Poultry Research Laboratory, and Forestry Science Laboratory; the Department of Interior's (DOI) Southeast Field Station and Georgia Cooperative Fish and Wildlife Research Unit; and EPA's Ecosystems Research Division.

- The Richard B. Russell Agricultural Research Center is a unit of USDA's Agricultural Research Service (ARS) located on the

¹¹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

campus of the University of Georgia. It consists of five research divisions focusing on animal physiology, poultry microbiological safety, quality assessment, poultry processing and meat quality, and toxicology and mycotoxins. The specific research activities of some of the divisions focus on identifying the mechanisms that enhance reproductive efficiency and reduce carcass fat, developing the technologies to prevent or diminish the association of poultry with human enteropathogenic bacteria, and determining the structure of foods and fibers as related to processing characteristics and end-use quality. The research activities of other divisions focus on improving the ultimate microbiological quality of raw processed poultry and identifying the means of reducing or eliminating hazards of naturally occurring toxins of fungal or plant origin that adversely affect animals or human health, thereby lowering the value of agricultural commodities. This federal R&D center, together with the Southeastern Poultry Research Laboratory described immediately below, annually receives approximately \$16.8 million of federal R&D funds and has about 200 FTEs.

- The Southeast Poultry Research Laboratory is also a unit of USDA's ARS located on the campus of the University of Georgia. It conducts research on diseases that afflict poultry and humans. Specific research activities of this laboratory focus on basic and applied research in diagnostics, prevention, and control strategies; prediction of disease outbreaks; molecular epidemiology; and understanding disease pathogenesis. The funding and staffing information for this federal R&D unit is included in those presented immediately above for the Richard B. Russell Agricultural Research Center.
- The Forestry Science Laboratory is a unit of the Southern Research Station (SRS) inside USDA's Forest Service. It is on the campus of the University of Georgia and works in close coordination with a unit in Research Triangle Park, North Carolina, to quantify the microbial and metabolic processes governing southern forest productivity and sustainability. SRS

conducts research on natural resource management and sustainability and creates the technology needed to sustain and enhance southern forest ecosystems. Specific research activities of this unit include studies on forest ecology, fire ecology, smoke management, and harvesting and wood properties of forests of the Atlantic Coastal Plain; R&D on effective, environmentally acceptable management options to control insects attacking seed orchards, tree nurseries, and plantations; analyses of the interactions of land use and forest management practices on arthropod populations with regard to their functional role as decomposers, as pollinators of rare plants, and as prey for endangered species; control measures for nonnative, invasive species; and the assessment of outdoor recreation and wilderness in forest ecosystems, with a particular focus on supply-and-demand trends, economic values, and benefits to rural communities. This federal R&D unit annually receives approximately \$4 million of federal R&D and has about 47 employees.

- The Southeast Field Station is a unit of the Patuxent Wildlife Research Center inside DOI's U.S. Geological Survey (USGS). It conducts research on migratory birds, waterfowl harvests, wildlife habitats, environmental contaminants, endangered species, and wildlife populations. Specific research activities of this unit include studying the status and trends of biological resources, investigating the effects of ecological processes and human impacts on biological resources; and restoring and maintaining sustainable ecological systems. This federal R&D unit, in combination with federal R&D funds allocated to the Southern Regional Supervisor, annually receives approximately \$847,000 of federal R&D funds and has about 11 FTEs.
- The Georgia Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It conducts research on fish and wildlife ecology. Specific research activities of this unit include studying forest wildlife populations on national wildlife refuges; investigating the availability, use, and relative value of cool-water springs as thermal refuge for bass; and looking at the impact of geese on

the ecosystem. This federal R&D unit annually receives approximately \$192,000 of federal R&D funds and has about four FTEs.

- The Ecosystems Research Division is a unit of the EPA's National Exposure Research Laboratory headquartered in Research Triangle Park, North Carolina. It conducts research on organic and inorganic chemicals, greenhouse gas biogeochemical cycles, and land-use perturbations that create direct and indirect, chemical, and nonchemical stressor exposures and potential risks to humans and ecosystems. It develops comprehensive models based on fundamental studies of stressor behavior to predict exposures in multimedia environments, to simulate the interactions of the climate system and the terrestrial biosphere, and to evaluate the aggregate causes of ecological stress, including land-use change/management, within a watershed/regional context. This federal R&D unit annually receives approximately \$12.3 million of federal R&D funds and has about 50 FTEs. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Atlanta, Georgia, is home to most of HHS's Centers for Disease Control and Prevention, the Agency for Toxic Substances and Disease Registry, and the Southeast Regional Laboratory; units of DOD's Army Research Laboratory and the Office of Naval Research; and DOI's Aviation Management Program and Georgia District Office of Water Resources.

- The Centers for Disease Control and Prevention (CDC) is the unit of HHS with primary responsibility for promoting health and quality of life by preventing and controlling disease, injury, and disability. CDC's National Center for Infectious Diseases conducts research on the infectious diseases that are new or reemerging (e.g., hantavirus, hemorrhagic fever), as well as older infectious diseases (e.g., malaria, pneumonia) that are becoming resistant to the drugs used to combat them. CDC's National Center for HIV, STD, and TB Prevention conducts research on the development of vaccines against these diseases, as

well as various ways to prevent their spread. CDC's National Center for Chronic Disease Prevention and Health Promotion conducts research on arthritis, diabetes, cardiovascular diseases, cancer, and other diseases that are prolonged, do not resolve spontaneously, and are rarely cured completely. CDC's National Center for Injury Prevention and Control conducts research on ways to reduce the morbidity, disability, mortality, and costs associated with injuries. CDC's National Center for Environmental Health conducts research on the prevention of illness, disability, and death from interactions between people and the environment. CDC's National Immunization Program conducts research on the use, efficacy, and adverse effects of vaccines. CDC's Public Health Practice Program Office conducts research on the public health workforce, the effectiveness of public health organizations, the scientific capacity of public health laboratories, and the systems required to manage public health. CDC's Epidemiology Program Office conducts research on the investigation of epidemics and the surveillance of public health. All of these CDC units are headquartered in Atlanta. The largest of CDC's units, the National Institute for Occupational Safety and Health, is headquartered in Washington, D.C., with sites in Ohio, West Virginia, Pennsylvania, and Washington. Altogether, the Atlanta-based portion of the CDC annually receives approximately \$145 million of federal R&D funds and has about 778 FTEs.

- The Agency for Toxic Substances and Disease Registry is a unit of HHS. It works to prevent exposure and adverse human health effects and diminished quality of life associated with exposure to hazardous substances from waste sites, unplanned releases, and other sources of pollution present in the environment. It conducts R&D activities focusing on the public health assessments of hazardous and toxic substances. The agency is headquartered in Atlanta and maintains 10 regional offices, as well as an office in Washington, D.C. Its funding comes primarily from the Superfund account controlled by the EPA, while a sister HHS unit, the Centers for Disease Control and

Prevention, performs many of its administrative functions. This federal unit annually receives approximately \$9 million of federal R&D funds, only about \$3 million of which is spent on in-house activities, and employs about 400 people, only a small portion of whom are directly involved in R&D activities.

- The Southeast Regional Laboratory is a unit of HHS's Food and Drug Administration. It conducts research on the safety and efficacy of human drugs. This federal unit annually receives approximately \$812,000 of federal R&D funds and has about seven FTEs directly involved in R&D activities.
- The Georgia Institute of Technology facility is a unit of DOD's Army Research Laboratory. The laboratory is headquartered in Adelphi, Maryland, with additional sites in Aberdeen, Maryland; White Sands, New Mexico; Cleveland, Ohio; Hampton, Virginia; and Eatontown, New Jersey. This specific unit conducts research on information science and technology to support warfighter analysis. This unit annually receives about \$1.7 million of federal R&D funds, approximately \$1.5 million of which is spent on in-house activities, and employs about 13 civilians.
- R&D Management Command is a unit of the Office of Naval Research (ONR) inside DOD. ONR is headquartered in Arlington, Virginia, and provides R&D managers to oversee the extramural R&D programs of the Navy and Marine Corps performed by universities, nonprofit organizations, or for-profit companies. ONR sponsors extramural R&D programs in information, electronics, and surveillance; ocean, atmosphere, and space; engineering, materials, and physical science; human systems; and naval expeditionary warfare. This federal unit annually receives approximately \$606,000 of federal R&D funds to support the in-house management activities of about 13 FTEs.
- The Aviation Management Program is a unit of DOI's USGS. It provides aircraft services for USGS researchers, including train-

ing, mapping, and the census of animal populations, such as bears. This federal R&D unit annually received approximately \$62,000 of federal R&D funds and had one FTE. This unit was phased out in 1999.

- The Georgia District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.9 million in federal R&D funds.

Augusta, Georgia, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the VA Medical Center in Augusta is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 130 projects with total funding of approximately \$1 million. These R&D activities focus on a wide range of topics, including schizophrenia, dementia, Alzheimer's disease, and cerebrovascular disorders.

Byron, Georgia, is home to USDA's Southeastern Fruit and Tree Nut Research Laboratory.

- The Southeastern Fruit and Tree Nut Research Laboratory is a unit of USDA's ARS. It conducts research on methods to enhance the production, value, and safety of pecan, peach, nectarine, and plum crops. Specific research activities of the laboratory include the development of husbandry strategies and research on arthropod, microbial, and nematode pests. This federal R&D unit annually receives approximately \$2.4 million of federal R&D funds and has about 30 FTEs.

Dawson, Georgia, is home to USDA's National Peanut Research Laboratory.

- The National Peanut Research Laboratory is a unit of USDA's ARS. It conducts research on developing technology to address the major problems of the U.S. peanut industry, including reducing the risks associated with peanut production, processing, marketing, and food safety aspects. Specific research activities of this laboratory include the studies of production, harvesting, curing, grading, handling, storage, and aflatoxin prevention. This federal R&D unit annually receives approximately \$2.1 million of federal R&D funds and has about 30 FTEs.

Decatur, Georgia, is to home of a DVA R&D unit.

- While the principal focus of the VA Medical Center Atlanta, located in Decatur, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 285 projects with total funding of approximately \$5 million. These R&D activities focus on a wide range of topics, including aging, cancer, and antiviral agents.

Fort Benning, Georgia, is home to a unit of DOD's Army Research Institute (ARI) and its Dismounted Battlespace Battle Laboratory.

- The Infantry Forces Research Unit is part of DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are located in Fort

Rucker, Alabama; Fort Leavenworth, Kansas; Fort Knox, Kentucky; Fort Bragg, North Carolina; Orlando, Florida; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. It conducts research on training and personnel performance to enhance individual and unit performance across the range of Army missions. Its research activities focus on training, leader development, and soldier support, particularly those skills pertaining to the needs of the infantry. Among the unit's current research are projects examining the training of soldiers and units to get the most out of emerging technologies, the Land Warrior system, technologies for urban operations, and the modernized Bradley Fighting Vehicle. Other research investigates the optimal design and use of new training technologies, such as virtual environments and CD-based instruction. In addition to conducting research, the unit provides technical expertise and research support to the U.S. Army Infantry Center and School and to the Army as a whole. This federal unit annually receives about \$1.5 million of federal R&D funds, approximately \$790,000 of which are spent on in-house R&D activities, and has about nine civilian personnel directly involved in R&D activities.

- The Dismounted Battlespace Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. It conducts research on dismounted soldiers to define requirements needed to expand and dominate the battlespace, maintain a lethal reach over an adversary, and mass weapons systems effectively while dispersing forces and individual soldiers throughout the battlefield. Specific research activities of this laboratory focus on such matters as improving combat identification for light forces, dismounted soldier digitization, and conducting modeling and simulations of the battle activities of the dismounted soldier. This federal unit annually receives about \$499,000 of federal R&D funds, only a portion of which is spent in-house, and has 17 civilian person-

nel, only a portion of whom are directly involved in R&D activities.

Fort Gordon, Georgia, is home to one of DOD's Battle Command Battle Laboratories.

- The Battle Command Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. This unit is one of three laboratories focusing specifically on battle command matters. The other two are in Fort Leavenworth, Kansas, and Fort Huachuca, Arizona. Together, the three Battle Command Battle Laboratories teach the art and science of battle command and information warfare to commanders to enable them to operate anywhere on the battlefield, as well as on the move. This particular laboratory assesses whether available commercial equipment can meet the needs of the Army with little or no modifications. Specific R&D activities of this laboratory focus on such areas as modeling and simulation of communications equipment and networks. This federal unit annually receives about \$808,000 of federal R&D funds, only a portion of which is spent in-house, and has 11 civilian personnel, only a portion of whom are directly involved in R&D activities.

Griffin, Georgia, is home of USDA's Regional Plant Introduction Station.

- The Regional Plant Introduction Station is a unit of USDA's ARS located on the campus of the University of Georgia at Griffin. It conducts research on the genetic resources of agricultural and horticultural crops, including wild species, wild and weedy relatives, landraces, obsolete and current cultivars, and genetic stocks. At present, the collections of the unit represent more than 250 genera and 1,400 species from almost every country in the world. Specific research activities of this laboratory include helping curators conserve and manage genetic resources in a more effective and cost-efficient manner. This federal R&D

unit annually receives approximately \$1.6 million of federal R&D funds and has about 20 FTEs.

Savannah, Georgia, is home to the Department of Commerce's (DOC) Gray's Reef National Marine Sanctuary.

- The Gray's Reef National Marine Sanctuary is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). Such sanctuaries conduct research on the marine environment to identify areas of special national significance stemming from their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific R&D activities of this unit include studying fisheries resources, evaluating sampling techniques for long-term monitoring of hard bottom reef fish assemblages in the South Atlantic Bight, and studying sessile invertebrate colonization and community development on hard substrate. This federal unit annually receives approximately \$72,500 of federal R&D funds and has two FTEs.

Tifton, Georgia, is home to USDA's Georgia Coastal Plain Experiment Station and Insect Biology and Population Management Research Laboratory.

- The Georgia Coastal Plain Experiment Station is a unit of USDA's ARS located on the campus of the University of Georgia at Tifton. It consists of three research divisions focusing on forage and turf, the Southeast watershed, nematodes, weeds, and crops. It conducts research on breeding methods, genetic populations, breeding lines, and cultivars of forage grasses and legumes to improve yield and quality. Specific research activities of this station include studies on resistance to pests, tolerance of environmental stress, and adaptation to small-farm environments as well as mechanized culture, harvesting, and handling. This federal R&D unit, together with the Insect Biology and Population Management Research Laboratory described immediately below, annually receives approximately \$7.6 million of federal R&D funds and has about 93 FTEs.

- The Insect Biology and Population Management Research Laboratory is a unit of USDA's ARS located on the campus of the University of Georgia at Tifton. It conducts research on developing technologies leading to sustainable pest management strategies for the southeastern United States. Specific research activities of this laboratory include identifying, developing, and releasing germplasm with resistance to insect pests and aflatoxin contamination for sustainable agricultural production systems and using resistant germplasm to minimize insect damage and/or aflatoxin contamination in corn, sorghum, peanuts, and forage grasses. Other research activities focus on developing technologies for sustainable integrated management of arthropod pests among crops and developing, evaluating, and facilitating implementation of insect population management technologies for sustainable cropping systems. The funding and staffing information for this federal R&D unit are included in those presented immediately above for the Georgia Coastal Plain Experiment Station.

FEDERAL R&D GRANTS TO GEORGIA ENTITIES

Every major institution of higher education in Georgia is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Emory University, Georgia Institute of Technology (Georgia Tech), the University of Georgia, the Medical College of Georgia (MCG), Morehouse School of Medicine (MSM), Georgia State University (GSU), and Clark Atlanta University (CAU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to Georgia Tech are \$4 million each from NASA and EPA and \$1 million from

DOE. Most of the comparable grants going to the University of Georgia come from DOE (\$3 million), DOC (\$1 million), and EPA (\$1 million).

Table 11.1 – Sources of Federal R&D Grants to Higher Education in Georgia

	HHS		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Emory	\$104M	508	\$3M	62	\$2M	10	\$1M	9	\$109M	589
Georgia Tech	\$4M	27	\$14M	254	\$16M	78	\$10M	132	\$43M	491
U of Georgia	\$14M	89	\$10M	148	<\$1M	5	\$14M	395	\$38M	637
MCG	\$14M	74	<\$1M	2	0	0	0	0	\$14M	76
MSM	\$11M	20	0	0	0	0	<\$1M	6	\$11M	26
GSU	\$7M	36	\$3M	32	0	0	<\$1M	14	\$11M	82
CAU	\$2M	9	<\$1M	5	\$2M	9	\$1M	28	\$5M	51
Other	\$4M	25	\$3M	18	\$1M	8	\$5M	58	\$14M	109
Total	\$160M	788	\$33M	521	\$21M	110	\$31M	642	\$245M	2,061

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Georgia also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Boys and Girls Clubs of America in Atlanta (\$2 million), Skidaway Institute of Oceanography in Savannah (\$1 million), the Georgia State Department of Human Resources in Atlanta (\$1 million), the Atlanta AIDS Research Consortium (\$1 million), and Microcoating Technologies in Chamblee (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extra-

mural R&D of more than \$100 million. In a recent year, small businesses in Georgia received 42 SBIR awards totaling \$12 million. Examples include a \$700,000 award from DOD (Army) to Satimo, Inc., in Acworth for development of an advanced microwave camera for 3-D imaging of subsurface objects in snow and frozen ground and a \$600,000 award from NASA to Search Technology, Inc., in Norcross for work on a pilot-centered turbulence assessment and monitoring system.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Georgia are ones valued more than \$6.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Georgia every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN GEORGIA

Several entities in Georgia also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from DOD to Lockheed Martin Aeronautical Systems in Marietta, which in FY 1998 received close to \$1.7 billion from a continuing Air Force R&D contract to develop the F-22 stealth fighter. In addition, the Boeing Company (\$10 million), Scientific Research Corp. (\$5 million), Amoco Polymers, Inc. (\$3 million), and IXL, Inc. (\$3 million), received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. Georgia Tech (\$30 million), Emory University (\$9 million), Mercer University (\$5 million), the University of Georgia

(\$5 million), and CAU (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants. Note that Mercer University does not appear by name in the table in the section above, because it received only \$800,000 in grants for FY 1998.

A total of \$38 million of federal R&D dollars was also received in FY 1998 by entities located in Georgia in the form of cooperative agreements. By far the largest of these cooperative agreements (\$9 million in FY 1998) came from DOE to the University of Georgia in Athens to operate the Savannah River Ecology Laboratory in Aiken, South Carolina. Other federal agencies awarding cooperative agreements to Georgia-based entities include DOD, NSF, and USDA.

Chapter 12

Federal Research and Development in Hawaii

- Approximately \$223 million of federal R&D funds are spent each year in Hawaii.
- Hawaii ranks 37th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 5 percent of all federal funds spent in Hawaii each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

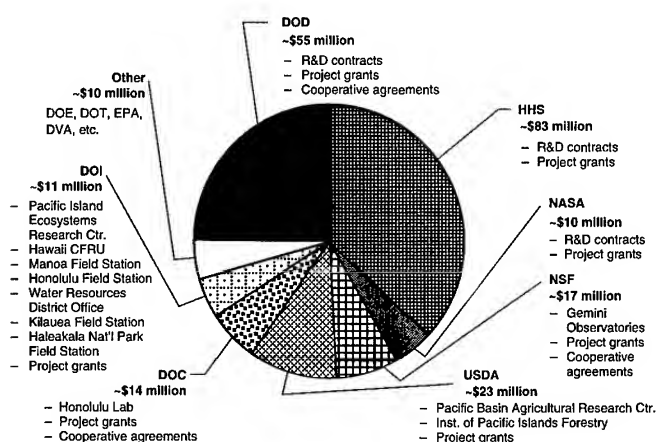


Figure 12.1 – Sources of Federal R&D Dollars Spent in Hawaii
(Total Federal R&D ~\$223 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$223 million annually in Hawaii on research and development (R&D) activities. On average, federal R&D dollars account for approximately 5 percent of all federal funds spent in Hawaii each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Hawaii. Foremost among these agencies are the Department of Health and Human Services (HHS) and the Department of Defense (DOD), which account for 37 and 25 percent of all federal R&D dollars spent in the state, respectively. The Department of Agriculture (USDA), the National Science Foundation (NSF), the Department of Commerce (DOC), the Department of Interior (DOI), and the National Aeronautics and Space Administration (NASA) account for an additional 10, 8, 6, 5, and 5 percent of all federal R&D dollars spent in Hawaii, respectively. The remaining federal R&D dollars come collectively from the Department of Energy (DOE) and several other federal agencies.¹²

All federal R&D dollars spent in Hawaii either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Hawaii.

FEDERAL R&D UNITS IN HAWAII

Hilo, Hawaii, is home to USDA's Pacific Basin Agricultural Research Center.

- The U.S. Pacific Basin Agricultural Research Center is a unit of USDA's Agricultural Research Service (ARS) located on the campus of the University of Hawaii at Hilo. It houses the Na-

¹² For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

tional Clonal Germplasm Repository for Tropical and Subtropical Fruit and Nut Crops, which evaluates, preserves, and distributes germplasm of tropical and subtropical fruit and nut crops. It also houses the Tropical Fruit and Vegetable Research Laboratory, which studies the factors that limit the productivity of fruits and vegetables; develops environmentally acceptable strategies for the management of crop pests; develops methods for controlling quarantine pests; and identifies ways of increasing the profitability of marine species while reducing the ecological impact of harvesting them. This federal R&D unit annually receives approximately \$8.7 million of federal R&D funds and has about 71 FTEs.

Honolulu, Hawaii, is home to USDA's Institute of Pacific Islands Forestry; DOC's Honolulu Laboratory; DOI's Pacific Island Ecosystems Research Center, Hawaii Cooperative Fishery Research Unit, Manoa Field Station, Honolulu Field Station, and Hawaii District Office of Water Resources; and a Department of Veterans Affairs (DVA) R&D unit.

- The Institute of Pacific Islands Forestry is a unit of the Pacific Southwest Research Station inside USDA's Forest Service. It conducts research on the restoration of ecosystem functions, forested wetland ecosystems, and control of nonindigenous species. Specific research activities of this institute include the conservation of threatened and endangered species, and exotic invasive species research. This federal R&D unit annually receives approximately \$2.1 million of federal R&D funds and has about 15 employees.
- The Honolulu Laboratory is a unit of the Southwest Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts research on fish biology and ecology, ecosystems and environment, stock assessment, fishery management and performance, and protected species. Specific research activities include studies on tuna and billfish resources of the Pacific Ocean, assessment of the magnitude of commercially important fish and shellfish species, and

investigation of population recovery of marine turtles and the Hawaiian monk seal. This federal unit annually receives approximately \$4.6 million of federal R&D funds and has about 56 FTEs, only a portion of whom are involved in R&D activities.

- The Pacific Island Ecosystem Research Center is a unit of DOI's U.S. Geological Survey (USGS). It conducts research on native bird species recovery, avian pox and malaria, Hawaiian predators, and feral pigs. Specific research activities of this unit include developing a serological test for avian malaria and studying the possibility of translocating the endangered Laysan duck. This federal R&D unit annually receives approximately \$121,000 of federal R&D funds and has about five FTEs.
- The Hawaii Cooperative Fishery Research Unit is part of DOI's USGS. It is on the Manoa campus of the University of Hawaii. It conducts research on freshwater, estuarine, and inshore marine ecology. Specific research activities of this unit include studying the life history of fishes and invertebrates; and analyzing aquatic ecosystems and trophic systems. This federal R&D unit annually receives approximately \$135,000 of federal R&D funds and has one FTE.
- The Manoa Field Station is a unit of the Pacific Island Ecosystems Research Center inside DOI's USGS. It is on the Manoa campus of the University of Hawaii. Specific research activities of this unit include studying conservation biology of the Hawaiian silversword, plant ecology and restoration of Hawaiian bogs, and vegetation of Palau. This federal R&D unit annually receives approximately \$553,000 of federal R&D funds and has about two FTEs.
- The Honolulu Field Station is a unit of the National Wildlife Health Center inside DOI's USGS. Specific research activities of this unit include evaluating the mortality of seabirds and endangered species; assessing wildlife health on lands added to the National Wildlife Refuge system; and investigating Hawaiian

wildlife diseases. This federal R&D unit annually receives approximately \$166,000 of federal R&D funds and has about two FTEs.

- The Hawaii District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.1 million in federal R&D funds.
- While the principal focus of the Honolulu VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 19 projects with total funding of approximately \$150,000. These R&D activities focus on a wide range of topics, including posttraumatic stress disorder, ethnicity, and Alzheimer's disease.

Kilauea, Hawaii, is home to DOI's Kilauea Field Station.

- The Kilauea Field Station is a unit of the Pacific Island Ecosystems Science Center inside DOI's USGS. Kilauea Field Station is the sum of two merged units, the Hawaii Field Station and the Hawaii Volcanoes National Park Field Station. They conduct

research in avian biology and disease, invertebrate biology, marine and aquatic biology, and plant ecology, focusing on the status and distribution of endangered plants and animals. Specific research activities of this unit include avian diseases, the recovery of native bird species, and the restoration of habitats. These federal R&D units combined annually receive \$1.2 million in federal R&D funds and have about 21 FTEs.

Makawao, Hawaii, is home to DOI's Haleakala National Park Field Station.

- The Haleakala National Park Field Station is a unit of the Pacific Island Ecosystems Research Center inside DOI's USGS. It conducts research on protecting native ecosystems and native species and develops ways to combat threats from invasive alien species. Specific research activities of this unit include recovery planning for Maui and Hawaii endangered plant taxa; studying ways to control the Argentine ant within Haleakala National Park; and discovering mechanisms of invasion of intact rain forest by nonnative plant species. This federal R&D unit annually receives approximately \$172,000 of federal R&D funds and has about two FTEs.

Mauna Kea, Hawaii, is home to a portion of NSF's Gemini Observatories.

- The Gemini Observatories project is a partnership among the United States, the United Kingdom, Canada, Australia, Chile, Brazil, and Argentina, which is headquartered in Tucson. With NSF through its National Optical Astronomy Observatories FFRDC headquartered in Tucson, Arizona, acting as the executive agent for this project, one eight-meter optical/infrared telescope is in operation in Mauna Kea, Hawaii, and a second is under construction in Chile. Both telescopes are designed to operate on-site or remotely. The total U.S. contribution to this international R&D effort has annually totaled approximately \$35 million of federal R&D funds in recent years, a sizable portion of which is spent in Hawaii.

FEDERAL R&D GRANTS TO HAWAII ENTITIES

Every major institution of higher education in Hawaii is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and NASA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Hawaii. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and NASA to parties at this institution and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to University of Hawaii are ones from DOD (\$3 million), USDA (\$3 million), DOC (\$2 million), and DOE (\$2 million).

Table 12.1 – Sources of Federal R&D Grants to Higher Education in Hawaii

Institution	HHS		NSF		NASA		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Hawaii	\$18M	50	\$10M	179	\$4M	110	\$10M	230	\$43M	569
Other	<\$1M	2	0	0	0	0	0	0	<\$1M	2
Total	\$18M	52	\$10M	179	\$4M	110	\$10M	230	\$43M	571

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Hawaii also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Kuakini Health System in Honolulu (\$2 million), Pacific Health Research Institute in Honolulu (\$1 million), Hawaii Biotechnology Group, Inc., in Aiea (\$1 million), and the Oceanic Institute in Waimanalo (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Hawaii received 19 SBIR awards totaling close to \$2.5 million. Examples include a \$500,000 award from DOD (Air Force) to Orincon Corp. in Kailua for work on the application of wavelets, fractal geometry, and statistics to automatic target recognition for laser radar ("ladar") systems and a \$200,000 award from DOC to Oceanic Laboratories, Inc., in Honolulu to develop an omnidirectional cloud height indicator.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Hawaii are ones valued at more than \$1.2 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Hawaii every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN HAWAII

Several entities in Hawaii also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. A large portion of these funds go to Science and Technology International, which in FY 1998 received close to \$2 million from DOD for R&D contracts in support of programs such as the Advanced Airborne Hyperspectral Imaging System for the Navy. In addition, Pacific Health Research Institute (\$2 million), the Kuakini Health System (\$1 million), and Papa Ola Lokahi, Inc. (\$500,000), re-

ceived significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Pacific Health Research Institute and the Kuakini Health System. The University of Hawaii (\$9 million) also received contracts in FY 1998 from various federal agencies to conduct R&D for the federal government. One of these contracts (\$2 million) was for the Science Surveillance, Epidemiology, and End Results Program for the Division of Cancer Control and Population, while another (\$1 million) was for a Women's Health Initiative clinical trial. Although this amount is notable, it does not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$15 million of federal R&D dollars was also received in FY 1998 by entities located in Hawaii in the form of cooperative agreements. The largest of these cooperative agreements (\$7 million in FY 1998) came from DOD to the Natural Energy Laboratory of Hawaii Authority in Kailua Kona to manage the National Defense Center of Excellence for Research in Ocean Sciences. Another of these cooperative agreements (\$859,000 in FY 1998) came from DOC to the University of Hawaii to operate the Joint Institute for Marine and Atmospheric Research (JIMAR). Other federal agencies awarding cooperative agreements to Hawaii-based entities include the Department of Interior and DOC.

Chapter 13

Federal Research and Development in Idaho

- Approximately \$274 million of federal R&D funds are spent each year in Idaho.
- Idaho ranks 32nd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 10 percent of all federal funds spent in Idaho each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

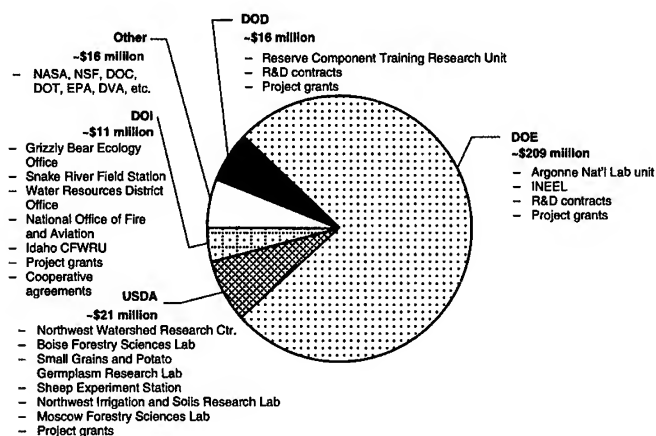


Figure 13.1 – Sources of Federal R&D Dollars Spent in Idaho
(Total Federal R&D ~\$274 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$274 million annually in Idaho on research and development (R&D) activities. On average, federal R&D dollars account for approximately 10 percent of all federal funds spent in Idaho each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Idaho. Foremost among these agencies is the Department of Energy (DOE), which accounts for 76 percent of all federal R&D dollars spent in the state. The Department of Agriculture (USDA), the Department of Defense (DOD), and the Department of Interior (DOI) account for an additional 8, 6, and 4 percent of all federal R&D funds spent in Idaho, respectively. The remaining federal R&D funds come collectively from the National Science Foundation (NSF), the Department of Transportation (DOT), the Department of Health and Human Services (HHS), and several other federal agencies.¹³

All federal R&D dollars spent in Idaho either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Idaho.

FEDERAL R&D UNITS IN IDAHO

Aberdeen, Idaho, is home to USDA's Small Grains and Potato Germplasm Research Laboratory.

- The Small Grains and Potato Germplasm Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of the University of Idaho. It conducts research on potato and small grains germplasm enhancement and culti-

¹³ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

var development. Specific research activities of this lab include evaluating and developing improved potato, barley, wheat, and oat germplasm; conducting studies on the inheritance of disease resistance; and performing plant molecular genetic research. This federal R&D unit annually receives approximately \$2.5 million of federal R&D funds and has about 23 FTEs.

Boise, Idaho, is home to DOD's Reserve Component Training Research Unit, USDA's Northwest Watershed Research Center and Boise Forestry Sciences Lab, DOI's Snake River Field Station, National Office of Fire and Aviation, and Idaho District Office of Water Resources, and a Department of Veterans Affairs (DVA) Medical Center.

- The Reserve Component Training Research Unit is part of DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are located in Orlando, Florida; Fort Benning, Georgia; Fort Knox, Kentucky; Fort Rucker, Alabama; Fort Leavenworth, Kansas; Fort Bragg, North Carolina; Fort Hood, Texas; Heidelberg, Germany; and Fort Monroe, Virginia. The unit conducts R&D to improve the efficiency and effectiveness of the performance of Army Reserve and Army National Guard soldiers and units. Specific research activities of this unit include studying the use of weapons simulators and supporting training strategies, assessing the cost-effectiveness of distributed training, and evaluating the use of Reserve Component volunteers for overseas peacekeeping missions. This federal R&D unit annually receives approximately \$487,000 in federal R&D funds and has about four civilians directly involved in R&D activities.
- The Northwest Watershed Research Center is a unit of USDA's ARS. It conducts research on developing quantitative descriptions of hydrologic processes and interactive influences of climate, soils, vegetation, topography, and management on rangeland watersheds. Specific research activities include the development of models for management of water resources in rangeland ecosystems, rangeland restoration, rangeland hy-

drology and erosion, and remote sensing of rangeland resources. This federal R&D unit annually receives approximately \$1.8 million of federal R&D funds and has about 20 FTEs.

- The Boise Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on regional watersheds and ecosystems. Specific research activities of this lab include studying soil and water management, ecology and silviculture of fir and pine ecosystems, riparian-stream ecology and management, and fish habitats. This federal R&D unit annually receives approximately \$2.2 million of federal R&D funds and has about 10 employees.
- The Snake River Field Station is a unit of the Forest and Rangeland Ecosystem Science Center inside DOI's U.S. Geological Survey (USGS). Specific research activities of this unit include studying raptor distribution and ground squirrel demographics, developing spatial models for vegetation-prey-predator systems, conducting global climate change research, and studying bighorn sheep–livestock interactions and pygmy rabbit habitat and behavior. This federal R&D unit annually receives approximately \$997,000 of federal R&D funds and has about 10 FTEs.
- The National Office of Fire and Aviation is a unit of DOI's Bureau of Land Management that is headquartered at the National Interagency Fire Center. It conducts research on wildland fires. This federal unit annually receives approximately \$5.3 million of federal R&D funds.
- The Idaho District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial con-

tamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1 million in federal R&D funds.

- While the principal focus of the Boise VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 70 projects with total funding of approximately \$700,000. These R&D activities focus on a wide range of topics, including antibiotics, obstructive lung diseases, and aging.

Dubois, Idaho, is home to USDA's U.S. Sheep Experiment Station.

- The U.S. Sheep Experiment Station is a unit of USDA's ARS. It conducts research to develop methods of improving the efficiency of wool production and propagation of range sheep while maintaining the natural resource environment. Specific research activities of this unit include genetics, range nutrition, feed utilization, and biological control of noxious weeds. This federal unit annually receives approximately \$2 million of federal R&D funds and has about 18 FTEs.

Idaho Falls, Idaho, is home to DOE's Argonne National Laboratory-West and DOE's Idaho National Engineering and Environmental Laboratory.

- The Argonne National Laboratory-West is part of a federally funded research and development center (FFRDC) sponsored by

DOE and operated by the University of Chicago. It is co-located with DOE's Idaho National Engineering and Environmental Laboratory. The other portion of this FFRDC is located in Argonne, Illinois. Although basic physics research is the primary focus of the laboratory, it also conducts studies and tests of the factors relevant to the decommissioning of reactors and other facilities and the preparation of spent fuel for disposal. The specific R&D facilities at the laboratory include an experimental breeder reactor, a fuel cycle facility, a zero power physics reactor, and a transient reactor test facility. This federally owned and contractor-operated laboratory annually receives approximately \$63 million of core funding, virtually all of which is spent on specific R&D projects, and has about 945 employees. A portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

- Idaho National Engineering and Environmental Laboratory is an FFRDC sponsored by DOE and operated by Bechtel BWXT Idaho, LLC. It conducts research on chemical sciences, materials processing, biotechnology, and environmental sciences. Specific examples include electric vehicle research and biodegradable products for stripping metal. In addition to a large proportion of nonnuclear projects, research at the laboratory also includes nuclear technology development and materials production. This federally owned and contractor-operated laboratory annually receives approximately \$548 million of core funding and conducts an estimated \$218 million of specific R&D projects. The laboratory has about 9,000 employees. A portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

Kimberly, Idaho, is home to USDA's Northwest Irrigation and Soils Research Laboratory.

- The Northwest Irrigation and Soils Research Laboratory is a unit of USDA's ARS. This facility researches and develops integrated water, soil, plant nutrient, and crop management practices for irrigated agriculture. Specific research activities of this

lab include estimating methods and models to relate water use to crop yield, developing new irrigation and management methods to minimize losses of soil nutrients and chemicals, tillage and nutrient management practices to enhance plant growth, and climate and management effects on soil properties. This federal R&D unit annually receives approximately \$2.6 million of federal R&D funds and has about 40 FTEs.

Moscow, Idaho, is home to USDA's Moscow Forestry Sciences Laboratory and DOI's Idaho Cooperative Fish and Wildlife Research Unit and Grizzly Bear Ecology Office.

- The Moscow Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on forest ecosystems, root diseases, and soil biology, and engineering technology. Specific research activities of this lab include studying the biology and ecological genetics of interior west forests, developing root disease and soil management techniques, and developing methods for predicting and minimizing the effects of forest roads on soil and water resources. This federal R&D unit annually receives approximately \$3.1 million of federal R&D funds and has about 60 employees.
- The Idaho Cooperative Fish and Wildlife Research Unit is a unit of DOI's USGS. It is on the Moscow campus of the University of Idaho. It conducts research on the ecology and management of fish and vertebrate populations in local stream and terrestrial habitats. Specific research activities of this unit include studying the effects of sediment and turbidity on fish and vertebrate populations, investigating factors affecting salmon survival and migration, developing methods for estimating wildlife populations, and protecting biological diversity through preserve design. This federal R&D unit annually receives approximately \$435,000 of federal R&D funds and has about four FTEs.
- The Grizzly Bear Ecology Office is a unit of the Forest and Rangeland Science Center inside DOI's USGS. It is on the campus of the University of Idaho. It conducts research on grizzly

bears. Specific research activities of this unit include defining landscapes suitable for restoration of grizzly bears in Idaho. This federal R&D unit annually receives approximately \$83,000 in federal R&D funds and has one FTE. This unit closed in 1999.

FEDERAL R&D GRANTS TO IDAHO ENTITIES

Every major institution of higher education in Idaho is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by USDA, DOD, and NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Idaho and Boise State University (BSU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by USDA, DOD, and NSF to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to University of Idaho are ones totaling close to \$1 million each from HHS, DOE, and NASA.

Table 13.1 – Sources of Federal R&D Grants to Higher Education in Idaho

Institution	USDA		DOD		NSF		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Idaho	\$3M	175	\$1M	4	\$2M	29	\$3M	25	\$9M	233
BSU	0	0	\$1M	4	<\$1M	6	0	4	\$1M	14
Other	0	0	0	0	<\$1M	3	<\$1M	7	<\$1M	10
Total	\$3M	175	\$2M	8	\$2M	38	\$3M	36	\$10M	257

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these

funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Idaho also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Idaho State Department of Insurance in Boise, Precision Irrigation Control Systems, Inc., in Soda Springs, Treasure Valley Drug and Alcohol Coalition in Boise, and Rocky Mountain Resource Labs, Inc., each receiving between \$100,000 and \$200,000.

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Idaho received six SBIR awards totaling close to \$600,000. Examples include a \$100,000 award from HHS to Rocky Mountain Resource Labs, Inc., in Jerome to develop wet vacuum units for sampling foodborne bacteria and a \$50,000 award from USDA to Western Ag Research in Blackfoot for work on a maintenance-free soil water monitoring system for improved irrigation management.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Idaho are ones valued at more than \$2.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Idaho every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN IDAHO

Several entities in Idaho also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to Micron Technology, Inc., which in FY 1998 received close to \$8 million from DOD for two large R&D contracts with the Army. In addition, Sci-entech, Inc. (\$1 million), Frontline Solutions (\$500,000), and Global Technologies, Inc. (\$500,000), received significant R&D contracts from federal agencies in FY 1998.

A total of \$20 million of federal R&D dollars was also received in FY 1998 by entities located in Idaho in the form of cooperative agreements. The largest of these cooperative agreements (\$2 million in FY 1998) came from DOE to the Idaho Operations Office in Idaho Falls to develop the technology roadmap research program for the steel industry. Other federal agencies awarding cooperative agreements to Idaho-based entities include NSF and USDA.

Chapter 14

Federal Research and Development in Illinois

- Approximately \$1.4 billion of federal R&D funds are spent each year in Illinois.
- Illinois ranks 17th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 7 percent of all federal funds received by Illinois for purposes other than the direct support of individuals (i.e., such entitlements as retirement, and disability, and housing assistance) is spent on R&D.

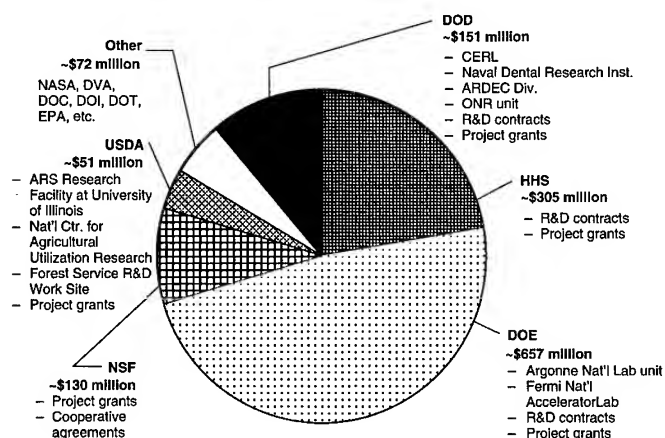


Figure 14.1 – Sources of Federal R&D Dollars Spent in Illinois
(Total Federal R&D ~\$1.4 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$1.4 billion annually in Illinois on research and development (R&D) activities. On average, federal R&D dollars account for approximately 7 percent of all federal funds received by Illinois for purposes other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Illinois. Foremost among these agencies is the Department of Energy (DOE), which accounts for 48 percent of the federal R&D dollars spent in the state. The Department of Health and Human Services (HHS), the Department of Defense (DOD), and the National Science Foundation (NSF) account for an additional 22, 11, and 10 percent, respectively. The remaining federal R&D dollars spent in Illinois come collectively from the Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), and several other agencies.¹⁴

All federal R&D dollars spent in Illinois either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities located in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Illinois.

FEDERAL R&D UNITS IN ILLINOIS

Argonne, Illinois, is home to DOE's Argonne National Laboratory-East.

- Argonne National Laboratory-East is a part of a federally funded research and development center (FFRDC) sponsored by DOE and operated by the University of Chicago. The other portion of this FFRDC is in Idaho Falls, Idaho. The laboratory is home to more than 200 R&D programs, ranging from studies

¹⁴ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

of the atomic nucleus to global climate change. It also designs, builds, and operates essential R&D facilities that would be financially prohibitive for a single university or company to build and operate. Among the laboratory's R&D facilities are the Advanced Photon Source, the Intense Pulsed Neutron Source, and the Argonne Tandem Linear Accelerator System. This federally owned and contractor-operated facility annually receives approximately \$320 million of core funding and conducts an estimated \$237 million of specific R&D projects. The laboratory has about 3,555 employees. A portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

Batavia, Illinois, is home to DOE's Fermi National Accelerator Laboratory.

- Fermi National Accelerator Laboratory, commonly referred to as Fermilab, is an FFRDC sponsored by DOE and operated by University Research Association, Inc. (UAR), a consortium of 89 universities in the United States, Canada, Japan, and Italy—most of which are U.S.-based. The laboratory explores the fundamental nature of matter and energy. In pursuit of this mission, it operates the world's highest-energy particle accelerator, the Tevatron, and the world's only hadron collider. Thousands of scientists from around the world, as well as 36 states, use Fermilab's facilities to carry out research at the frontiers of particle physics. This federally owned and contractor-operated laboratory annually receives approximately \$279 million of core funding, virtually all of which is spent on specific R&D projects, and has about 2,200 employees. A portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

Champaign-Urbana, Illinois, is home to DOD's Construction Engineering Research Laboratories and USDA's Agricultural Research Service (ARS) Research Facility at the University of Illinois.

- The Construction Engineering Research Laboratories are a unit of the Engineer Research and Development Center within

DOD's U.S. Army Corps of Engineers. The center is headquartered in Vicksburg, Mississippi, with related units in Hanover, New Hampshire, and Alexandria, Virginia. Its R&D activities address the question of how best to support sustainable military installations. Specifically, its research focuses on increasing the Army's ability to more efficiently construct, operate, and maintain its installations and ensure environmental quality and safety at a reduced life-cycle cost. It is located in Champaign to facilitate working with the College of Engineering and other units of the University of Illinois at Champaign-Urbana. This federal unit annually receives about \$46 million of federal R&D funds, approximately \$20 million of which are spent on in-house activities, and has about 305 civilian personnel. This core staff is supplemented by an additional 100 people from the university.

- The ARS Research Facility at the University of Illinois is a unit of USDA's ARS. It consists of three research divisions focusing on plant physiology and genetics, crop protection, and photosynthesis. The facility conducts research in different areas that contribute to optimal agricultural management. One division researches and identifies rate-limiting steps in nitrogen metabolism in addition to maintaining and evaluating soybean germplasm and corn genetic stock. The research of another division focuses on improving pest management systems to ensure their efficiency and environmental safety, while the research of a third division focuses on identifying and modifying rate-limiting factors of the photosynthesis process. This federal R&D unit annually receives about \$3.7 million of federal R&D funds and has about 42 FTEs.

Chicago, Illinois, is home to a unit of DOD's Office of Naval Research.

- The R&D Management Command is a unit of the Office of Naval Research (ONR) inside DOD. ONR is headquartered in Arlington, Virginia, and provides R&D managers to oversee the extramural R&D programs of the Navy and Marine Corps performed by universities, nonprofit organizations, or for-profit

companies. ONR sponsors extramural R&D programs in information, electronics, and surveillance; ocean, atmosphere, and space; engineering, materials, and physical science; human systems; and naval expeditionary warfare. This federal unit annually receives approximately \$652,000 of federal R&D funds to support the in-house management activities of about 14 FTEs.

Evanston, Illinois, is home to a USDA Forest Service R&D Work Site.

- The R&D Work Site is a unit of the North Central Forest Experiment Station inside USDA's Forest Service. It conducts research on the management of forest environments for urban populations. Specific research activities of this unit include developing and providing information and guidelines for managing urban forest settings based on improved understanding or urbanites' values, perceptions, and interactions in these settings. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about seven employees.

Great Lakes, Illinois, is home to DOD's Naval Dental Research Institute.

- The Naval Dental Research Institute is a unit of DOD. It researches, develops, and tests new methods and materials for limiting oral disease, reducing dental emergencies, maximizing operational readiness, and promoting dental health for Navy and Marine Corps personnel. This federal unit annually receives approximately \$1.8 million of federal R&D funds, all of which are spent on in-house activities, and has about 11 civilian personnel.

Hines, Illinois, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the VA Medical Center in Hines, Great Lakes Health Care System/Edward Hines Jr. Hospital, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally

owned and operated facility was the site of 592 projects with total funding of approximately \$7.2 million. These R&D activities focus on a wide range of topics, including spinal cord injuries, obstructive lung diseases, drug treatments and therapies, and prostatic neoplasms.

Peoria, Illinois, is home to USDA's National Center for Agricultural Utilization Research.

- The National Center for Agricultural Utilization Research (NCAUR) is a unit of USDA's ARS. It conducts research on new uses of agricultural commodities for industrial and food products. Organized into 10 research divisions, this federal R&D unit maintains a mixed portfolio of interdisciplinary science, covering the spectrum from fundamental to applied research, including food quality and safety, mycotoxins, bioactive agents, oil chemicals, plant polymers, biomaterial processing, fermentation processing, microbial properties, biopolymers, and new crops. It also serves as USDA's primary Technology Transfer Facility. This federal R&D unit annually receives approximately \$26 million of federal R&D funds and has about 257 FTEs.

Rock Island, Illinois, is home to a unit of DOD's Armament Research, Development, and Engineering Center.

- The Rock Island Site is a unit of the Army's Armament Research, Development, and Engineering Center inside DOD. The center is headquartered in Picatinny, New Jersey, with subordinate research activities in Rock Island, Illinois; Watervliet, New York; and Aberdeen, Maryland. The center's focus is on integrating complex armament technologies into guns, ammunition, and fire control systems through research, development, acquisition, and sustainment. The Rock Island Site provides essential production capability for artillery/gun mounts, equipment integration, spare parts, and other equipment for the armed forces, as well as the assembly of tools, sets, kits, and outfits that support equipment in the field. This federal unit annually receives approximately \$50,000 of federal R&D funds for

in-house activities and has about 130 civilian personnel, only a fraction of whom are directly involved in R&D activities.

Urbana, Illinois, is home to DOI's Illinois District Office of Water Resources.

- The Illinois District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.9 million in federal R&D funds.

Chicago and Danville, Illinois, are home to VA Medical Centers. While the principal focus of all of these federally owned and operated facilities is providing medical care to veterans, each center is also the location of a number of research activities. In a recent year, these federally owned and operated facilities have been the site of 486 R&D projects with total funding of approximately \$4 million. These R&D activities focus on a wide range of topics, including radiotherapy, prostatic neoplasms, lung neoplasms, and drug therapy.

FEDERAL R&D GRANTS TO ILLINOIS ENTITIES

Every major institution of higher education in Illinois is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Illinois, the University of Chicago, Northwestern University, Loyola University, Illinois Institute of Technology (IIT), Southern Illinois University (SIU), Finch University of Health Sciences/Chicago Medical School (FUHS/CMS), Northern Illinois University (NIU), and Chicago State University. The table below shows the total number of R&D grants that were active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to U of Illinois are \$14 million from DOE, \$8 million from USDA, \$4 million from NASA, \$3 million from the Department of Education, and \$2 million from the Environmental Protection Agency (EPA). The grants in this same category going to the U of Chicago are split between DOE and NASA.

Table 14.1 – Sources of Federal R&D Grants to Higher Education in Illinois

	HHS		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Illinois	\$86M	518	\$40M	585	\$15M	97	\$34M	543	\$174M	1,743
U of Chicago	\$96M	389	\$16M	218	\$1M	8	\$7M	106	\$120M	721
Northwestern	\$75M	363	\$21M	270	\$10M	65	\$8M	106	\$114M	804
Loyola	\$15M	110	\$1M	15	<\$1M	2	<\$1M	2	\$17M	129
IIT	\$4M	7	\$1M	19	\$3M	11	\$1M	15	\$8M	52
SIU	\$3M	39	\$2M	37	<\$1M	1	\$1M	22	\$6M	99
FUHS/CMS	\$4M	35	<\$1M	2	<\$1M	0	0	0	\$4M	37
NIU	\$1M	11	\$1M	29	\$1M	3	<\$1M	4	\$3M	47
Chicago State	\$1M	2	<\$1M	2	<\$1M	1	0	0	\$1M	5
Other	\$2M	24	\$1M	37	<\$1M	1	<\$1M	15	\$4M	77
Total	\$287M	1,498	\$82M	665	\$30M	189	\$51M	813	\$450M	3,165

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Chemistry Department at the University of Illinois.

Several other nonacademic institutions in Illinois also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Rush-Presbyterian-St. Luke's Medical Center in Chicago (\$30 million), the American College of Obstetricians and Gynecologists (\$6 million), and the American College of Surgeons in Peoria (\$4 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Illinois received 68 SBIR awards totaling \$15 million. Examples include a \$600,000 award from the Navy to Horrigan Analytics in Chicago to develop a configurable mine countermeasure dynamic planning tool and a \$200,000 award from USDA to C&A Country Gardens in Clinton to develop a foam in-place mulching method for specialty crops.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Illinois are ones valued at more than \$5.4 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from the U.S. Geological Survey (USGS) inside the Department of the Interior (DOI) to the Water Resources Research Institute in Illinois every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN ILLINOIS

Several entities located in Illinois also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far, the majority of these funds go from DOD to Northrop Grumman, which in FY 1998 received close to \$276 million in contracts for R&D work on such programs as the Joint Surveillance and Target Attack Radar System (JSTARS) and the F-15E aircraft. In addition, North Central Regional Educational Laboratory, Primex Technologies, and IITRI each received between \$18 million and \$30 million of R&D contracts from federal agencies in FY 1998. The University of Illinois and Northwestern University also received contracts from various federal agencies to conduct R&D for the federal government that collectively totaled \$15 million in FY 1998. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$71 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities located in Illinois. By far the largest of these cooperative agreements (\$10 million) came from DOE to M-C Power Corporation for research on the design of molten carbonate fuel cells. Other federal agencies awarding cooperative agreements to Illinois-based entities include NSF, DOD, and DOC. Among these latter cooperative agreements are awards supporting three of NSF's Science and Technology Centers—the Center of Astrophysical Research in Antarctica, which is headquartered at the University of Chicago; the Center for Advanced Cement-Based Materials at Northwestern University; and the center for Superconductivity at the University of Illinois-Urbana. The latter center is the largest federally funded university-based research effort on high-temperature superconductivity in the United States. In addition, Illinois is home to two of NSF's Materials Research Science and Engineering Centers—the Materials Center at the University of Chicago and the Materials Research Center at Northwestern University in Evanston, Illinois.

Chapter 15

Federal Research and Development in Indiana

- Approximately \$475 million of federal R&D funds are spent each year in Indiana.
- Indiana ranks 26th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 6 percent of all federal funds spent in Indiana each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

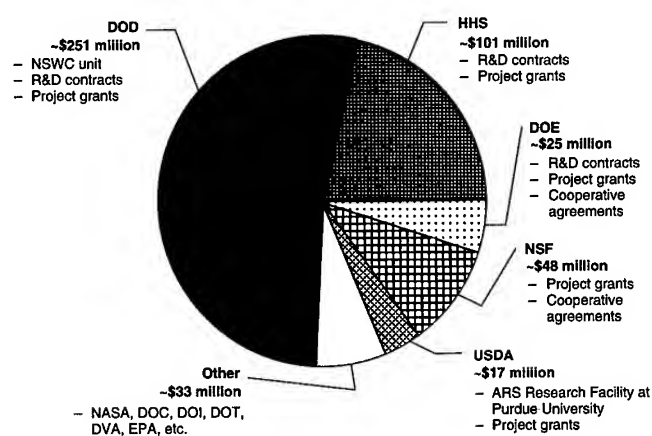


Figure 15.1 – Sources of Federal R&D Dollars Spent in Indiana
(Total Federal R&D ~\$475 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$475 million annually in Indiana on research and development (R&D) activities. On average, federal R&D dollars account for approximately 6 percent of all federal funds spent in Indiana each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Indiana. Foremost among these agencies are the Departments of Defense (DOD) and Health and Human Services (HHS), which account for 53 and 21 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF), the Department of Energy (DOE), the Department of Agriculture (USDA), and the National Aeronautics and Space Administration (NASA) account for an additional 10, 5, 4, and 3 percent of all federal R&D dollars spent in Indiana, respectively. The remaining federal R&D dollars come collectively from Department of Interior (DOI), the Department of Transportation (DOT), and several other agencies.¹⁵

All federal R&D dollars spent in Indiana either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Indiana.

FEDERAL R&D UNITS IN INDIANA

Crane, Indiana, is home to a DOD's Naval Surface Warfare Center Crane Division.

- The Naval Surface Warfare Center Crane Division is a unit of DOD. It provides engineering, logistics, and maintenance for the Navy's weapon and electronic systems, ordnance, and asso-

¹⁵ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

ciated equipment and components. These include electronic warfare, small arms, microelectronic technology, conventional ammunition engineering, electronic module test and repair, pyrotechnics, microwave components, electrochemical power systems, acoustic sensors test, radar engineering and industrial support, physical security, night vision/electro-optics, and gun weapon systems. This federal unit annually receives approximately \$25.1 million of federal R&D funds for in-house activities and has about 3,209 civilian personnel, only a small portion of whom are involved in R&D activities.

Indianapolis, Indiana, is home to DOI's Indiana District Office of Water Resources and a Department of Veterans Affairs (DVA) R&D unit.

- The Indiana District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1 million in federal R&D funds.
- While the principal focus of the Richard L. Roudebush VA Medical Center in Indianapolis is providing medical care to

veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 231 projects with total funding of approximately \$3 million. These R&D activities focus on a wide range of topics, including diabetes, alcoholism, AIDS, Alzheimer's disease, pulmonary diseases, and cancer.

Porter, Indiana, is home to DOI's Lake Michigan Ecological Station.

- Lake Michigan Ecological Station, also call the Indiana Dunes Field Station, is a unit of the Great Lakes Science Center inside DOI's USGS. It conducts research on the terrestrial and aquatic biological diversity of the ecosystems of the Great Lakes region and the Lake Michigan basin in particular. Specific research activities of this unit include developing ways to quantify the impacts of ecosystem processes, such as fire succession on biodiversity; studying population biology and dynamics of endangered plants and animals; and researching the impact of pollution on interstitial beach sand, wetland, and aquatic ecosystems. This federal R&D unit annually receives approximately \$340,000 in federal R&D funds and has about nine FTEs.

West Lafayette, Indiana, is home to USDA's Agricultural Research Service (ARS) Research Facility at Purdue University.

- The ARS Research Facility at Purdue University is a unit of USDA's ARS. It consists of three research divisions focusing on crop production and pest control, soil erosion, and livestock behavior. One division conducts research on the biochemical basis and genetic control of disease and insect resistance in grain crops (wheat, corn, and sorghum) and the improvement of soybean germplasm for agronomic traits, consumer acceptance, and pest resistance. Another division develops technology for soil conservation. Yet another division observes livestock to enhance productivity in food-producing animals. This federal R&D unit annually receives approximately \$4.9 million of federal R&D funds and has about 48 FTEs.

FEDERAL R&D GRANTS TO INDIANA ENTITIES

Every major institution of higher education in Indiana is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, DOE, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Indiana University, Purdue University, and the University of Notre Dame. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, DOE, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Of the grants in the "Other Agencies" category going to the Indiana University, close to \$1 million each are from EPA and NASA. The grants in this same category going to Purdue come from USDA (\$7 million), NASA (\$2 million), DOC (\$1 million), and EPA (\$1 million).

Table 15.1 – Sources of Federal R&D Grants to Higher Education in Indiana

Institution	HHS		NSF		DOE		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Indiana University	\$82M	385	\$9M	189	\$4M	17	\$1M	10	\$2M	49	\$98M	650
Purdue	\$19M	129	\$15M	289	\$9M	30	\$10M	60	\$11M	490	\$64M	998
Notre Dame	\$4M	26	\$8M	146	\$1M	14	\$3M	19	<\$1M	16	\$16M	221
Other	\$1M	16	<\$1M	22	<\$1M	1	0	0	<\$1M	10	\$2M	49
Total	\$105M	556	\$32M	646	\$14M	62	\$14M	89	\$14M	565	\$180M	1,918

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the School of Materials Engineering at Purdue.

Several other nonacademic institutions in Indiana also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are M.A. Laboratory Animals in Indianapolis (\$2 million), the Indiana State Board of Health in Indianapolis (\$1 million), and Visual Computing Systems Corp. in Greenville (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Indiana received 24 SBIR awards totaling close to \$3 million. Examples include a \$600,000 award from NASA to Space Hardware Optimization Technology in Floyds Knobs for work on the multistage electrophoretic purification of cells, particles, and proteins and a \$100,000 award from HHS to Interscience Research, Inc., in Indianapolis to study the use of high-intensity ultrasound for prostate cancer treatment.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Indiana are ones valued at more than \$4.8 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Indiana every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN INDIANA

Several entities in Indiana also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific

R&D efforts. By far the majority of these funds go to ITT Industries, Inc., which in FY 1998 received close to \$72 million for such efforts as the engineering of weather-detecting instruments for NASA, and work on Near-Term Digital Radio (NTDR) prototypes for DOD (Army). In addition, Raytheon Co. (\$39 million), Rolls-Royce Allison (formerly Allison Engine Co.) (\$12 million), and Light Helicopter Turbine Engine Co. (\$5 million) received large R&D contracts from federal agencies in FY 1998. The University of Notre Dame (\$4 million), Purdue University (\$2 million), and Indiana University (\$1.5 million) also receive contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$17 million of federal R&D dollars was also received in FY 1998 by entities located in Indiana in the form of cooperative agreements. The largest of these cooperative agreements (\$6 million in FY 1998) came from DOE to Rolls-Royce Allison in Indianapolis for development of an industrial turbine system. Other federal agencies awarding cooperative agreements to Indiana-based entities include NSF and DOC. Among these latter cooperative agreements is an award supporting one of NSF's Materials Research Science and Engineering Centers—the Heterostructure Materials for Electronic Applications at Purdue University.

Chapter 16

Federal Research and Development in Iowa

- Approximately \$252 million of federal R&D funds are spent each year in Iowa.
- Iowa ranks 35th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 6 percent of all federal funds spent in Iowa each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

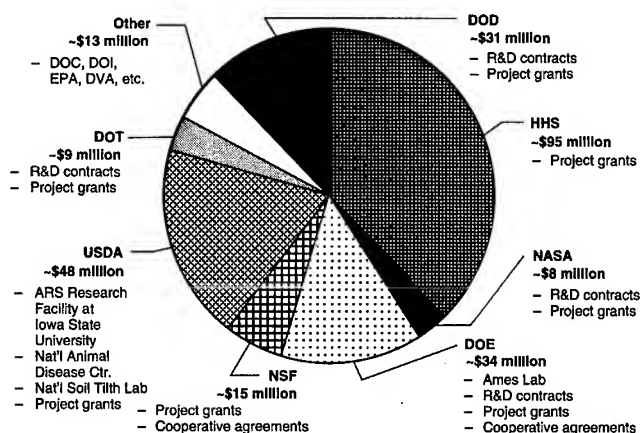


Figure 16.1 – Sources of Federal R&D Dollars Spent in Iowa
(Total Federal R&D ~\$252 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$252 million annually in Iowa on research and development (R&D) activities. On average, federal R&D dollars account for approximately 6 percent of all federal funds spent in Iowa each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Iowa. Foremost among these agencies is the Department of Health and Human Services (HHS), which accounts for 38 percent of all federal R&D dollars spent in the state. The Departments of Agriculture (USDA), Energy (DOE), and Defense (DOD) and the National Science Foundation (NSF) account for an addition 19, 14, 12, and 6 percent of all federal R&D dollars spent in Iowa, respectively. The remaining federal R&D dollars come collectively from the Department of Transportation (DOT), the National Aeronautics and Space Administration (NASA), and several other federal agencies.¹⁶

All federal R&D dollars spent in Iowa either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Iowa.

FEDERAL R&D UNITS IN IOWA

Ames, Iowa, is home to DOE's Ames Laboratory; the Department of Interior's (DOI) Iowa Cooperative Fish and Wildlife Research Unit; and USDA's Agricultural Research Service (ARS) Research Facility at Iowa State University, National Animal Disease Center, and National Soil Tilth Laboratory.

- Ames Laboratory is a federally funded research and development center (FFRDC) sponsored by DOE and operated by Iowa

¹⁶ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

State University. It conducts research on materials sciences, high-performance computing, and environmental science and management efforts. The laboratory seeks solutions to energy-related problems through the exploration of physics, chemistry, engineering, applied mathematics, and materials sciences. Recent research investigated ways to make parallel computing accessible and cost-effective and conducted geometric modeling to improve the efficiency of lasers and sensing devices. This federally owned and contractor-operated laboratory annually receives approximately \$24 million of core funding and conducts an estimated \$20 million of specific R&D projects. The laboratory has about 500 employees. A portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Iowa Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the campus of Iowa State University. It conducts research on the ecosystems of the Missouri River, Mississippi River, and northwest wetlands. Specific research activities of this unit include studies on the migrations of snow geese, canvasbacks, and other waterfowl in these ecosystems. Wildlife studies emphasize wetland ecology and agricultural effects on wildlife species and habitats. This federal R&D unit annually receives approximately \$236,000 in federal R&D funds and has about three FTEs.
- The ARS Research Facility at Iowa State University, is a unit of USDA's ARS. This facility comprises two research divisions focusing on corn insects and crop genetics and plant introduction. One division investigates ways to manage pests and improve germplasm of corn, soybeans, and cereals. Specific research activities of this division include studying molecular biology and biochemistry of grain quality in maize and mapping the soybean genome. The other division conducts germplasm-related research and encourages the use of germplasm and associated information for research, crop improvement, and product development. Specific research activities of this division

include improving the quality of germplasm maintenance. This federal R&D unit, together with the National Animal Disease Center and the National Soil Tilth Laboratory described immediately below, annually receives approximately \$26.7 million of federal R&D funds and has about 347 FTEs.

- The National Animal Disease Center is a unit of USDA's ARS located on the campus of Iowa State University. It consists of six research divisions focusing on avian and swine respiratory diseases, enteric diseases and food safety, metabolic disease and immunology, respiratory and neurologic disease, swine virology, and zoonotic diseases. One division develops methods for disease prevention and diagnosis to reduce poultry and swine bacterial and fungal disease, focusing on developing vaccines and immunodiagnostic test procedures. Three other divisions investigate bacterial and viral enteric pathogens and host immune responses related to economically significant diseases of cattle and swine; conduct research on metabolic diseases and immunology in dairy cattle; and study the pathogenesis of respiratory diseases of cattle, sheep, and goats. Two other divisions conduct research on viruses associated with economically important diseases of swine to develop methods by which such diseases can be controlled or eradicated, and the diagnosis of leptospirosis in cattle and swine using serologic, microbiologic, and biotechnologic methods. The funding and staffing information for this federal R&D unit are included in those presented immediately above for the ARS Research Facility.
- The National Soil Tilth Laboratory is a unit of USDA's ARS located on the campus of Iowa State University. It consists of two research divisions focusing on agricultural land management and soil and water quality. It conducts quantitative research on soil biological, chemical, and physical processes and their interaction as related to agricultural practices. Specific research activities of this laboratory include a study on the soils, geologic materials, aquifers, and hydrologic conditions surrounding 34 representative lagoons and basins in Iowa and a study that de-

finest the distribution, by hydrologic unit, of major sources, dominant losses, and immobilized nitrogen attributable to agriculture. The funding and staffing information for this federal R&D unit are included in those presented above for the ARS Research Facility.

Iowa City, Iowa, is home to DOI's Iowa District Office of Water Resources and a Department of Veterans Affairs (DVA) R&D unit.

- The Iowa District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.5 million in federal R&D funds.
- While the principal focus of the Iowa City VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 254 projects with total funding of approximately \$5 million. These R&D activities focus on a wide range of topics, including diabetes, neoplasms, gene expression regulation, drug therapy, and alcoholism.

FEDERAL R&D GRANTS TO IOWA ENTITIES

Every major institution of higher education in Iowa is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Iowa, Iowa State University, and the University of Northern Iowa (UNI). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and USDA to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Iowa are ones from NASA (\$5 million), DOD (\$3 million), and DOE (\$2 million). The comparable grants going to Iowa State include \$3 million from DOE and close to \$1 million each from EPA and NASA.

Table 16.1 – Sources of Federal R&D Grants to Higher Education in Iowa

Institution	HHS		NSF		USDA		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Iowa	\$94M	427	\$7M	144	<\$1M	6	\$11M	93	\$112M	670
Iowa State	\$10M	31	\$8M	157	\$11M	391	\$6M	58	\$34M	637
UNI	\$1M	3	<\$1M	1	<\$1M	3	<\$1M	3	\$1M	10
Other	\$2M	11	<\$1M	7	<\$1M	3	<\$1M	8	\$2M	29
Total	\$106M	472	\$15M	309	\$11M	403	\$17M	162	\$149M	1,346

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Iowa also receive federal R&D grants each year. Foremost among the institutions that received

R&D grants in FY 1998 are the Krell Institute in Ames (\$2 million), the Iowa State Department of Human Services in Des Moines (\$1 million), the Mercy Foundation in Des Moines (\$1 million), and Bioforce Laboratory, Inc., in Ames (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Iowa received six SBIR awards totaling close to \$600,000. Examples include a \$200,000 award from EPA to Brimstone Pipe Co. in Johnston to develop manufacturing methods for sulfur concrete sewer pipe and a \$100,000 award from the Air Force to Etrema Products, Inc., in Ames for work on an integrated electric actuator application to flight control technology.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Iowa are ones valued at more than \$5.8 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Iowa every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN IOWA

Several entities in Iowa also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to Rockwell International Corp., which in FY 1998 received close to \$50 million from DOD for work on such efforts as providing jam-resistant data termi-

nals for Joint Tactical Information Distribution System (JTIDS) and producing lightweight precision GPS receivers for the Air Force. In addition, the Iowa State Department of Public Health (\$1 million), Act, Inc. (\$600,000), and Metal Tech Industries (\$500,000) received significant R&D contracts from federal agencies in FY 1998. The University of Iowa (\$16 million) and Iowa State University (\$9 million) also receive contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$92 million of federal R&D dollars was also received in FY 1998 by entities located in Iowa in the form of cooperative agreements. By far the largest of these cooperative agreements (\$87 million in FY 1998) came from DOE to Midwest Power Systems, Inc., in Des Moines for work on innovative clean coal technology. Other federal agencies awarding cooperative agreements to Iowa-based entities include DOD and USDA.

Chapter 17

Federal Research and Development in Kansas

- Approximately \$165 million of federal R&D funds are spent each year in Kansas.
- Kansas ranks 39th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 3 percent of all federal funds spent in Kansas each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

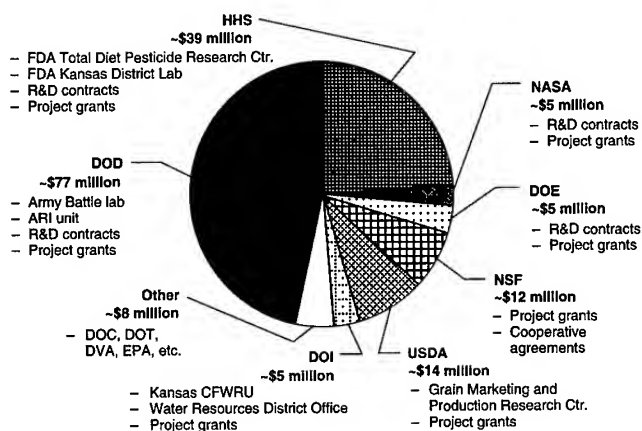


Figure 17.1 – Sources of Federal R&D Dollars Spent in Kansas
(Total Federal R&D ~\$165 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$165 million annually in Kansas on research and development (R&D) activities. On average, federal R&D dollars account for approximately 3 percent of all federal funds spent in Kansas each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Kansas. Foremost among these agencies are the Department of Defense (DOD) and the Department of Health and Human Services (HHS), which account for 47 and 23 percent of all federal R&D dollars spent in the state, respectively. The Department of Agriculture (USDA), the National Science Foundation (NSF), the Department of Energy (DOE), the Department of Interior (DOI), and the National Aeronautics and Space Administration (NASA) account for an additional 9, 7, 3, 3, and 3 percent of all federal dollars spent in Kansas, respectively. The remaining federal R&D dollars come collectively from the Department of Transportation and several other federal agencies.¹⁷

All federal R&D dollars spent in Kansas either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Kansas.

FEDERAL R&D UNITS IN KANSAS

Fort Leavenworth, Kansas, is home to DOD's Fort Leavenworth Research Unit and one of its Battle Command Battle Laboratories.

- The Fort Leavenworth Research Unit is part of DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are located

¹⁷ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

in Fort Rucker, Alabama; Fort Benning, Georgia; Fort Knox, Kentucky; Fort Bragg, North Carolina; Orlando, Florida; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. It conducts research to develop better training methods for Army leaders. Specific research activities of this unit include studying ways to develop the cognitive skills required under conditions of increased operational complexity, risk, and uncertainty and developing training and educational methods and materials for the Internet and the classroom. This federal R&D unit annually receives approximately \$1.3 million in federal R&D funds, only a portion of which is spent on in-house R&D activities, and has about seven civilian personnel directly involved in R&D activities.

- The Battle Command Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. This unit is one of three laboratories focusing specifically on battle command matters. The other two are in Fort Gordon, Georgia, and Fort Huachuca, Arizona. Together, the three Battle Command Battle Laboratories teach the art and science of battle command and information warfare to commanders to enable them to operate anywhere on the battlefield, as well as on the move. This particular laboratory conducts research on issues concerning the concepts and principles of command and provides overall direction for the Battle Laboratories. Specific R&D activities of this laboratory include studying how commanders lead and decide, how information impacts decisionmaking, and how information flows in high-performing organizations. This federal unit annually receives about \$836,000 of federal R&D funds, only a portion of which is spent in-house, and has three civilian personnel.

Lawrence, Kansas, is home to DOI's Kansas District Office of Water Resources.

- The Kansas District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D ac-

tivities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.1 million in federal R&D funds.

Lenexa, Kansas, is home to HHS's Total Diet Pesticide Research Center and Kansas District Laboratory.

- The Total Diet Pesticide Research Center is a unit of HHS's Food and Drug Administration (FDA) and is co-located with the FDA's Kansas City District Laboratory. The center and laboratory conduct research on pesticide residues in food, as well as the presence of radionuclides, industrial chemicals, toxic elements, trace and macro elements, vitamin B₆, and folic acid. The levels of pesticides found are used in conjunction with USDA food consumption data to estimate the total dietary intakes of the pesticide residues. These federal units annually receive approximately \$732,000 and have about eight FTEs directly involved in R&D activities.

Manhattan, Kansas, is home to USDA's Grain Marketing and Production Research Center, and DOI's Cooperate Fish and Wildlife Research Unit.

- The Grain Marketing and Production Research Center is a unit of the USDA's Agricultural Research Service (ARS) located on the campus of Kansas State University. It is composed of three divisions focusing on marketing of U.S. grain, plant science and entomology, and wind erosion. One division conducts research on the biochemical components in cereals that are directly related to grain end-use and processing quality. A second division conducts research to develop rapid automated technologies and instrumentation for wheat classification, grading, and single-kernel quality assessment and to develop methods for machine vision assessment of grain and grain product quality characteristics. The third division conducts research to develop ecologically based technologies to replace or reduce the use of traditional pesticides. Specific research activities of the unit include studying the ecology, population dynamics, and behavior of pest and beneficial insects and investigating new control techniques based on a knowledge of insect genetics, physiology, biochemistry, toxicology, and molecular biology. The divisions focusing on science and entomology and wind erosion are on the campus of Kansas State University. These federal R&D units combined annually receive approximately \$7.8 million of federal R&D funds and have about 73 FTEs.
- The Kansas Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Kansas State University. It conducts research to understand the ecological systems within the Great Plains. Specific research activities of this unit include studying ways for the diverse endemic wild animals and habitats to coexist with the human population. This federal R&D unit annually receives approximately \$253,000 and has three FTEs.

Wichita, Kansas, is home to a Department of Veterans Affairs (DVA) Medical Center.

- While the principal focus of the Wichita VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally

owned and operated facility was the site of 60 projects with total funding of approximately \$200,000. These R&D activities focus on a wide range of topics, including drug therapy, neoplasms, and radiotherapy.

FEDERAL R&D GRANTS TO KANSAS ENTITIES

Every major institution of higher education in Kansas is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, USDA, and DOE to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Kansas, Kansas State University, and Wichita State University. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, USDA, and DOE to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category going to the University of Kansas are from NASA (\$2 million), while the remainder are split among EPA, DOD, and the Department of Education. The comparable grants going to Kansas State include \$2 million from EPA and \$1 million from DOD.

Table 17.1 – Sources of Federal R&D Grants to Higher Education in Kansas

	HHS		NSF		USDA		DOE		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Kansas	\$34M	166	\$3M	81	<\$1M	3	<\$1M	9	\$3M	49	\$40M	308
Kansas State	\$4M	33	\$5M	74	\$5M	305	\$4M	14	\$4M	31	\$22M	457
Wichita State	\$1M	5	<\$1M	13	0	0	<\$1M	1	<\$1M	9	\$2M	28
Other	<\$1M	1	<\$1M	3	<\$1M	1	<\$1M	1	<\$1M	1	<\$1M	7
Total	\$39M	205	\$8M	171	\$5M	309	\$4M	25	\$8M	90	\$64M	800

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and un-

derstanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Medical Center at the University of Kansas.

Several other nonacademic institutions in Kansas also receive federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are the Center for Research (located at the University of Kansas) in Lawrence (\$9 million), Eagle Picher Industries, Inc., in Lenexa (\$1 million), Via Christi Regional Medical Center in Wichita (\$1 million), and the Kansas State Department of Health and Environment in Topeka (\$500,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Kansas received 14 SBIR awards totaling close to \$4.5 million. Examples include a \$750,000 award from the Army to Nantek, Inc., in Manhattan to develop reactive topical skin protectants against sulfur mustard and nerve agents and a \$750,000 award from HHS to Edge Enterprises, Inc., in Lawrence for work on community building strategies for inclusive classrooms.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Kansas are ones valued at more than \$3.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Kansas every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN KANSAS

Several entities in Kansas also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. A large portion of these funds go to AlliedSignal (now part of Honeywell), which in FY 1998 received close to \$6 million from DOD (Army) for engineering and manufacturing development of a Mortar Fire Control System. In addition, Boeing Company (\$5 million), the Center for Research (\$2 million), and Eagle Picher Industries, Inc. (\$1 million), received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by the Center for Research and Eagle Picher Industries. The University of Kansas (\$7 million) and Kansas State University (\$500,000) also receive contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$1.5 million of federal R&D dollars was also received in FY 1998 by entities located in Kansas in the form of cooperative agreements. The largest of these cooperative agreements (\$750,000 in FY 1998) came from NSF to the Center for Research in Lawrence to fund EPSCoR (Experimental Program to Stimulate Competitive Research) activities. Other federal agencies awarding cooperative agreements to Kansas-based entities include the Department of Interior and USDA.

Chapter 18

Federal Research and Development in Kentucky

- Approximately \$112 million of federal R&D funds are spent each year in Kentucky.
- Kentucky ranks 43rd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 1 percent of all federal funds spent in Kentucky each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

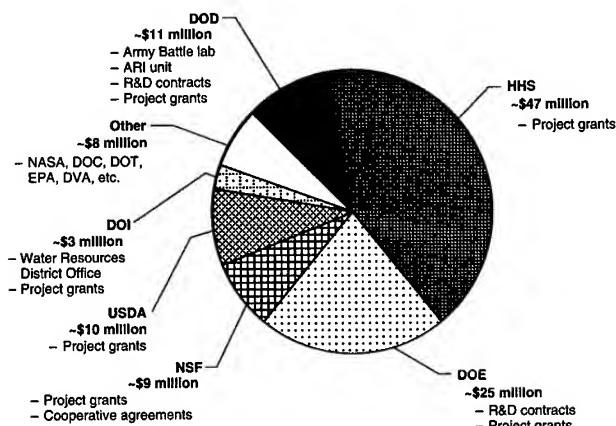


Figure 18.1 – Sources of Federal R&D Dollars Spent in Kentucky
(Total Federal R&D ~\$112 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$112 million annually in Kentucky on research and development (R&D) activities. On average, federal R&D dollars account for approximately 1 percent of all federal funds spent in Kentucky each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Kentucky. Foremost among these agencies is the Department of Health and Human Services (HHS), which accounts for 42 percent of all federal R&D dollars spent in the state. The Department of Energy (DOE), the Department of Defense (DOD), the Department of Agriculture (USDA), and the National Science Foundation (NSF) account for an additional 22, 10, 9, and 8 percent of all federal R&D dollars spent in Kentucky, respectively. The remaining federal R&D dollars come collectively from the Department of Interior (DOI), the National Aeronautics and Space Administration (NASA), and several other federal agencies.¹⁸

All federal R&D dollars spent in Kentucky either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Kentucky.

FEDERAL R&D UNITS IN KENTUCKY

Fort Knox, Kentucky, is home to a unit of DOD's Army Research Institute for Behavioral and Social Sciences and Mounted Maneuver Battlespace Battle Laboratory.

- The Armored Forces Research Unit is a unit of DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are located in Fort

¹⁸ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

Rucker, Alabama; Fort Benning, Georgia; Fort Leavenworth, Kansas; Fort Bragg, North Carolina; Orlando, Florida; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. This unit conducts R&D on improved training methods and training technologies focusing on the armor force. This federal unit receives approximately \$1.7 million in federal R&D dollars, only a portion of which is spent on in-house R&D activities, and employs about 13 civilian personnel directly involved in R&D activities.

- The Mounted Maneuver Battlespace Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. It conducts research on mounted maneuvers at the brigade level and below as they pertain and relate to full dimension operations of the current and future Army. Specific research activities of this laboratory focus on such matters as unmanned vehicle, semi-autonomous reconnaissance operations on the digitized battlefield, the future combat system constructive experiment, and small, low-cost interceptor devices. This federal unit annually receives about \$1.7 million of federal R&D funds, only a portion of which is spent in-house, and has three civilian personnel.

Lexington, Kentucky, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Lexington VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 286 projects with total funding of approximately \$1 million. These R&D activities focus on a wide range of topics, including fluorouracil, neoplasms, chemotherapy, and cerebrovascular disorders.

Louisville, Kentucky, is home to DOI's Kentucky District Office of Water Resources and a DVA R&D unit.

- The Kentucky District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$737,000 in federal R&D funds.
- While the principal focus of the Louisville VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 149 projects with total funding of approximately \$1.5 million. These R&D activities focus on a wide range of topics, including sepsis, pneumonia, congestive heart failure, diabetes, and microcirculation.

FEDERAL R&D GRANTS TO KENTUCKY ENTITIES

Every major institution of higher education in Kentucky is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, USDA, and NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Ken-

tucky, the University of Louisville, and Kentucky State University (KSU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, USDA, and NSF to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Kentucky is one for \$1 million from DOD, with the remainder split among EPA, DOE, and NASA. Most of the comparable grants going to the University of Louisville come from DOD and EPA.

Table 18.1 – Sources of Federal R&D Grants to Higher Education in Kentucky

Institution	HHS		USDA		NSF		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Kentucky	\$40M	258	\$6M	160	\$6M	143	\$3M	58	\$55M	619
U of Louisville	\$9M	58	0	0	\$1M	22	\$2M	13	\$11M	93
KSU	0	0	\$2M	26	0	0	<\$1M	1	\$2M	27
Other	<\$1M	8	<\$1M	2	<\$1M	4	\$1M	9	\$1M	23
Total	\$49M	324	\$8M	188	\$7M	169	\$6M	81	\$70M	762

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Kentucky also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Administar in Louisville (\$2 million), the Conference of Radiation Program Directors in Frankfort (\$1 million), and Murty Pharmaceuticals in Lexington (\$500,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extra-

mural R&D of more than \$100 million. In a recent year, small businesses in Kentucky received seven SBIR awards totaling close to \$2 million. Examples include a \$750,000 award from HHS to Speech Technology and Applied Research Co. in Lexington to develop a device for enhancing artificial larynx speech and a \$100,000 award from NSF to K&S Scientific, Inc., in Bowling Green for work on a pulsed neutron-based online coal analyzer.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Kentucky are ones valued at more than \$6.8 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Kentucky every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN KENTUCKY

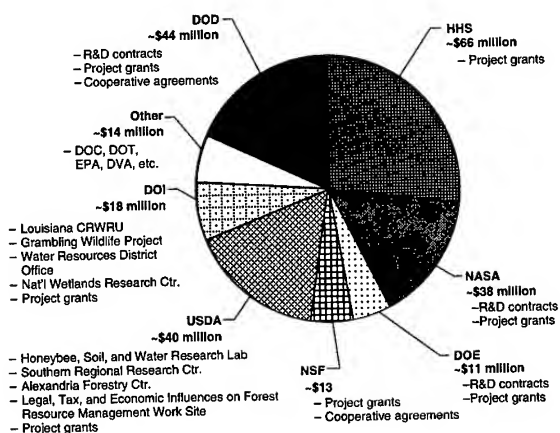
Several entities in Kentucky also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. A large portion of these funds go to Innovative Productivity, Inc., which in FY 1998 received close to \$3 million to operate the Manufacturing Technology Transfer Center for the Navy. In addition, Keco Industries, Inc. (\$1 million), A&P Technology, Inc. (\$1 million), and Murty Pharmaceuticals (\$1 million) received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Murty Pharmaceuticals. The University of Kentucky (\$3 million) also receives contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$3 million of federal R&D dollars was also received in FY 1998 by entities located in Kentucky in the form of cooperative agreements. The largest of these cooperative agreements came from DOE and NSF (one each for \$750,000 in FY 1998) to the University of Kentucky in Lexington to fund EPSCoR (Experimental Program to Stimulate Competitive Research) activities. Another cooperative agreement supports one of NSF's Materials Research Science and Engineering Centers—the Advanced Carbon Materials Center at the University of Kentucky. Other federal agencies awarding cooperative agreements to Kentucky-based entities include USDA and the Department of Interior.

Chapter 19

Federal Research and Development in Louisiana

- Approximately \$244 million of federal R&D funds are spent each year in Louisiana.
- Louisiana ranks 36th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 3 percent of all federal funds spent in Louisiana each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.



**Figure 19.1 – Sources of Federal R&D Dollars Spent in Louisiana
(Total Federal R&D ~\$244 million)**

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$244 million annually in Louisiana on research and development (R&D) activities. On average, federal R&D dollars account for approximately 3 percent of all federal funds spent in Louisiana each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Louisiana. Foremost among these agencies are the Departments of Health and Human Services (HHS), Defense (DOD), and Agriculture (USDA) and the National Aeronautics and Space Administration (NASA), which account for 27, 18, 16 and 16 percent of all federal R&D dollars spent in the state, respectively. The Department of Interior (DOI), the National Science Foundation (NSF), and the Department of Energy (DOE) account for an additional 7, 5, and 5 percent of all federal R&D dollars spent in Louisiana, respectively. The remaining federal R&D dollars come collectively from the Environmental Protection Agency (EPA), the Department of Commerce (DOC), and several other federal agencies.¹⁹

All federal R&D dollars spent in Louisiana either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Louisiana.

FEDERAL R&D UNITS IN LOUISIANA

Baton Rouge, Louisiana, is home to USDA's Honeybee, Soil, and Water Research Laboratory and DOI's Louisiana Cooperative Fish and Wildlife Research Unit and Louisiana District Office of Water Resources.

¹⁹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

- The Honeybee, Soil, and Water Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of Louisiana State University. It conducts research on honeybee breeding and genetic studies of the honeybee and transport and fate of agrochemicals in high water table soils. Specific research activities of the laboratory include studies to develop a genetic resistance to mites for honeybees and the development of improved water management systems and operating criteria to improve crop production. This federal R&D unit annually receives approximately \$2.7 million in federal R&D funds and has about 24 FTEs.
- The Louisiana Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the campus of Louisiana State University. It conducts research on aquaculture of crawfish, catfish, and other species with aquacultural potential in Louisiana and the southern United States. Specific research activities of this unit include a study of changes on the limnology and aquatic ecology in the Atchafalaya basin stemming from human activity. This federal R&D unit annually receives approximately \$266,000 in federal R&D funds and has about three FTEs.
- The Louisiana District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a wa-

tershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.3 million in federal R&D funds.

Grambling, Louisiana, is home to DOI's Grambling Wildlife Project.

- The Grambling Wildlife Project is a unit of DOI's USGS. It is on the campus of Grambling State University. Specific research activities of this unit include assisting and preparing minority students in the field of wildlife and fishery research. This federal R&D unit annually receives approximately \$88,000 in federal R&D funds and has one FTE.

Lafayette, Louisiana, is home to DOI's National Wetlands Research Center.

- The National Wetlands Research Center is a unit of DOI's USGS. It develops and disseminates scientific information on wetland habitats through a system of peer reviewed journal articles, databases, synthesis reports, workshops, conferences, technical assistance, training, and information/library services. Specific research activities of this center and its field unit in Baton Rouge include a broad array of projects on wetland ecology, values, management, restoration and creation; and research on the ecology of a wide variety of plant and animal species and ecosystems found in wetlands. These federal R&D units combined annually receive approximately \$3.8 million in federal R&D funds and have about 83 FTEs.

New Orleans, Louisiana, is home to USDA's Southern Regional Research Center and Legal, Tax, and Economic Influences on Forest Resource Management Work Site and a Department of Veterans Affairs (DVA) R&D unit.

- The Southern Regional Research Center, a unit of USDA's ARS, consists of eight research divisions focusing on commodity utilization, cotton fiber quality, cotton textile chemistry, cotton textile engineering, food and feed safety, food processing and sen-

sory quality, Formosan subterranean termites, and sugarcane. It conducts fundamental and applied research related primarily to postharvest processing, product enhancement, safety, and use of agricultural commodities produced in the southern United States. Specific research activities of the center include developing ways to improve fiber measurement technologies for such properties as length, strength, maturity, and surface friction; characterizing factors that contribute to contamination of food/feed/fiber commodities by mycotoxins; and developing chemical and biological methods to detoxify harmful contaminants in commodities. This federal R&D unit annually receives approximately \$25 million in federal R&D funds and has about 233 FTEs.

- The Legal, Tax, and Economic Influences on Forest Resource Management Work Site is a unit of the Southern Research Station inside USDA's Forest Service. It is on the campuses of Louisiana State University and Louisiana Tech. It conducts research on the effects of federal, state, and local taxes, laws, and regulations on forestry. Specific research activities of this unit and a sister unit in Tuskegee, Alabama, include analyzing export markets for southern softwood products and the economics of innovative silvicultural practices for southern forests. This federal R&D unit annually receives approximately \$930,000 of R&D funds and has about 10 employees.
- While the principal focus of the New Orleans VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 226 projects with total funding of approximately \$2 million. These R&D activities focus on a wide range of topics, including hypertension, heart disease, pain management, kidney disease, prostate cancer, posttraumatic stress disorder, and addictions.

Pineville, Louisiana, is home to USDA's Alexandria Forestry Center.

- The Alexandria Forestry Center is a unit of the Southern Research Station inside USDA's Forest Service. It is on the cam-

puses of Louisiana State University and Louisiana Tech. Specific research activities include providing fundamental knowledge on the ecology and physiology of southern pine species and even-aged management options to enhance and sustain the productivity of southern pine ecosystems. Other activities include improving methods for predicting and managing the southern pine beetle through acquisition and use of basic knowledge of its ecology and behavior and defining and applying fundamental chemistry, material science, and engineering principles to the utilization and processing of southern forest resources in an environmentally sound way. This federal R&D unit annually receives approximately \$3.5 million of federal R&D dollars and has about 43 employees.

Shreveport, Louisiana, is home to a DVA R&D unit.

- While the principal focus of the Shreveport VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 106 projects with total funding of approximately \$400,000. These R&D activities focus on a wide range of topics, including neoplasms, congestive heart failure, and prostatic disorders.

FEDERAL R&D GRANTS TO LOUISIANA ENTITIES

Every major institution of higher education in Louisiana is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, DOD, NSF, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the Louisiana State University system (LSU), Tulane University, the University of Louisiana system, and Southern University. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, DOD, NSF, and USDA to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to

the terms of these grants. Among the grants in the "Other Agencies" category going to LSU are ones from EPA (\$3 million), DOC (\$3 million), DOE (\$2 million), and NASA (\$2 million). Most of the comparable grants going to the University of Louisiana system are from EPA and those awarded to Southern University are split mainly among EPA and NASA.

Table 19.1 – Sources of Federal R&D Grants to Higher Education in Louisiana

	HHS		DOD		NSF		USDA		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
LSU	\$26M	192	\$8M	21	\$4M	117	\$5M	271	\$10M	75	\$54M	676
Tulane	\$27M	117	<\$1M	5	\$2M	53	0	0	\$1M	18	\$31M	193
U of Louisiana	\$2M	14	\$2M	4	\$2M	30	<\$1M	10	\$2M	18	\$7M	76
Southern U	\$1M	3	\$1M	4	<\$1M	3	\$1M	14	\$2M	31	\$6M	55
Other	\$1M	3	<\$1M	2	<\$1M	2	<\$1M	1	<\$1M	9	\$1M	17
Total	\$57M	329	\$11M	36	\$8M	205	\$7M	296	\$16M	151	\$99M	1,017

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Health Sciences Center at LSU.

Several other nonacademic institutions in Louisiana also receive federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are the Pennington Biomedical Research Center (located at LSU) in Baton Rouge (\$5 million), Children's Hospital in New Orleans (\$3 million), the Louisiana State Department of Health & Hospitals in New Orleans (\$1 million), and the Alton Ochsner Medical Foundation in New Orleans (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs

supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Louisiana received nine SBIR awards totaling close to \$2 million. Examples include a \$600,000 award from the Navy to Neptune Sciences, Inc., in Slidell to develop a family of miniature, expendable, environmental sensors and a \$100,000 award from NSF to The Venture Group in Lafayette to study chitosan-based biopolymers as additives to oil well drilling fluids.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Louisiana are ones valued at more than \$4.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Louisiana every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN LOUISIANA

Several entities in Louisiana also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to Textron, Inc., which in FY 1998 received close to \$23 million from the Army for engineering and manufacturing development of the Lightweight 155-mm Howitzer. In addition, Lockheed Martin Corp. (\$3 million), Neptune Sciences, Inc. (\$3 million), and John E. Chance and Assoc., Inc. (\$2 million), received significant R&D contracts from federal agencies in FY 1998. The University of Louisiana system (\$3 million), Tulane University (\$2 million), and LSU (\$2 million) also receive contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to

eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$29 million of federal R&D dollars was also received in FY 1998 by entities located in Louisiana in the form of cooperative agreements. The largest of these cooperative agreements (\$7 million in FY 1998) came from DOD (Navy) to the University of New Orleans campus of LSU to operate the Gulf Coast Region Maritime Technology Center. Other federal agencies awarding cooperative agreements to Louisiana-based entities include DOC and NSF.

Chapter 20

Federal Research and Development in Maine

- Approximately \$79 million of federal R&D funds are spent each year in Maine.
- Maine ranks 46th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 2 percent of all federal funds spent in Maine each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

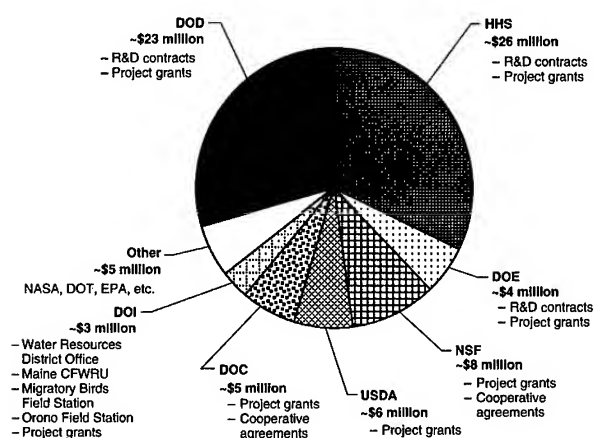


Figure 20.1 – Sources of Federal R&D Dollars Spent in Maine
(Total Federal R&D ~\$79 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$79 million annually in Maine on research and development (R&D) activities. On average, federal R&D dollars account for approximately 2 percent of all federal funds spent in Maine each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Maine. Foremost among these agencies are the Departments of Health and Human Services (HHS) and Defense (DOD), which account for 32 and 29 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF), and the Departments of Agriculture (USDA), Commerce (DOC), and Energy (DOE) account for an additional 10, 7, 6, and 5 percent of all federal R&D dollars spent in Maine, respectively. The remaining federal R&D dollars come collectively from the Department of Interior (DOI), the National Aeronautics and Space Administration (NASA), the Environmental Protection Agency (EPA), and several other federal agencies.²⁰

All federal R&D dollars spent in Maine either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Maine.

FEDERAL R&D UNITS IN MAINE

Augusta, Maine, is home to DOI's Maine District Office of Water Resources.

- The Maine District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA),

²⁰ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$251,000 in federal R&D funds.

Orono, Maine, is home to DOI's Maine Cooperative Fish and Wildlife Research Unit, Migratory Birds Field Station, and Orono Field Station.

- The Maine Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the Orono campus of the University of Maine. It conducts research on fish and wildlife and provides graduate-level training, including research experience, in fish and wildlife management. Specific research activities of this unit include quantifying the functional relationships between selected wildlife species and their habitats and assessing the status of selected waterbirds. This federal R&D unit annually receives approximately \$203,000 in federal R&D funds and has about two FTEs.
- The Migratory Birds Field Station is a unit of the Patuxent Environmental Science Center inside DOI's USGS. It conducts research on the effect of high mercury levels in fish from many lakes in this region on bald eagles. Specific research activities of this unit are focused on identifying habitat and food-chain impacts, such as localized high mercury concentrations. Such

studies help to maintain the eagle population. This federal R&D unit annually receives approximately \$227,000 in federal R&D funds and has about three FTEs.

- The Orono Field Station is a unit of the Leetown Science Center inside DOI's USGS. It conducts research on developing ways to restore the Atlantic salmon, which has been proposed for inclusion on the Endangered Species List as either threatened or endangered. Specific research activities of this unit include studying habitat needs and migratory routes and examining populations of wild Atlantic salmon for the presence of unique genetic differences. This federal R&D unit annually receives approximately \$141,000 in federal R&D funds and has one FTE.

FEDERAL R&D GRANTS TO MAINE ENTITIES

Every major institution of higher education in Maine is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by NSF, DOD, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Maine system. The table below shows the number of R&D grants active in FY 1998, highlighting those made by NSF, DOD, and USDA to parties at this institution and estimates of the total dollars transferred to them in FY

Table 20.1 – Sources of Federal R&D Grants to Higher Education in Maine

Institution	NSF		DOD		USDA		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Maine	\$3M	57	\$3M	9	\$3M	125	\$5M	28	\$14M	219
Other	\$1M	26	0	0	<\$1M	1	<\$1M	6	\$1M	33
Total	\$4M	83	\$3M	9	\$3M	126	\$5M	34	\$15M	252

1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Maine are ones from DOC (\$2 million), NASA (\$1 million), and HHS (\$1 million).

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Maine also receive federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are the Jackson Laboratory in Bar Harbor (\$25 million), Bigelow Laboratory for Ocean Sciences in West Boothbay Harbor (\$2 million), the Maine Medical Center in Portland (\$1 million), and the Maine State Department of Human Services in Augusta (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Maine received seven SBIR awards totaling close to \$1 million. Examples include a \$750,000 award from DOE to Biode, Inc., in Bangor for work on "piezoelectric" biosensors for bacterial detection and speciation and a \$75,000 award from DOC to Sensor Research and Development in Orono to develop a low-cost prefire detector.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Maine are ones valued at more than \$2.1 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute

in Maine every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MAINE

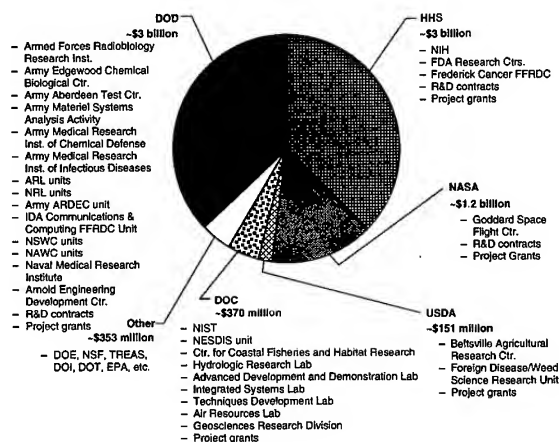
Several entities in Maine also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go from DOD to Fiber Materials, Inc., which in FY 1998 received close to \$3.5 million for support of the Army's Atmospheric Interceptor Technology (AIT) program. In addition, Sensor Research and Development (\$2 million), Intermat, Inc. (\$2 million), the Maine State Department of Human Services (\$2 million), and the Jackson Laboratory (\$1 million) received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Jackson Laboratory and the Department of Human Services. The University of Maine (\$100,000) also receives contracts from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$1.3 million of federal R&D dollars was also received in FY 1998 by entities located in Maine in the form of cooperative agreements. The largest of these cooperative agreements (\$400,000 in FY 1998) came from NSF to the Maine Science and Technology Foundation in Augusta to develop the Maine EPSCoR (Experimental Program to Stimulate Competitive Research) strategic implementation plan. Other federal agencies awarding cooperative agreements to Maine-based entities include DOC and USDA.

Chapter 21

Federal Research and Development in Maryland

- Approximately \$8.1 billion of federal R&D funds are spent each year in Maryland.
- Maryland ranks 2nd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 34 percent of all federal funds received by Maryland for purposes other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.



**Figure 21.1 – Sources of Federal R&D Dollars Spent in Maryland
(Total Federal R&D ~\$8.1 billion)**

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$8.1 billion annually in Maryland on research and development (R&D) activities. On average, federal dollars for R&D account for approximately 34 percent of all federal funds received by Maryland for purposes other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support R&D efforts fund significant R&D activities in Maryland. Foremost among these agencies are the Departments of Health and Human Services (HHS) and Defense (DOD), which account for 38 and 37 percent of all federal R&D dollars spent in the state. The National Aeronautics and Space Administration (NASA) and the Department of Commerce (DOC) account for an additional 15 and 5 percent of all federal R&D dollars spent in Maryland, respectively. The remaining federal R&D dollars come from the Department of Agriculture (USDA), the Department of Energy (DOE), the National Science Foundation (NSF), and several other federal agencies.²¹

All federal R&D dollars spent in Maryland either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants or contracts to entities located in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Maryland.

FEDERAL R&D UNITS IN MARYLAND

Aberdeen, Maryland, is home to DOD's Aberdeen Test Center, Edgewood Chemical Biological Center, Army Medical Research Institute of Chemical Defense, Army Materiel Systems Analysis Activity, a unit of the Army Research Laboratory, and a unit of the Armament Research, Development, and Engineering Center.

²¹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

- The Army's Aberdeen Test Center is a unit of DOD. Its primary responsibility involves the testing of a broad spectrum of military weapon systems and equipment, including armored vehicles, guns, ammunition, trucks, bridges, generators, night vision devices, and underwater marine systems. In addition, it develops test procedures, methodologies, and instrumentation to meet the test requirements of advancing military technologies. This federal facility annually receives about \$69 million of federal R&D funds, approximately \$31.6 million of which are spent on in-house activities, and has about 850 civilian personnel, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Edgewood Chemical Biological Center is a unit of DOD. It is the Army's principal R&D center for chemical and biological defense technology and engineering. It consists of several laboratories, including ones focused on surface spectroscopy and electron microscopy; environmental sciences, pharmacology, toxicology, biosciences, biotechnology, and related life sciences; bioprocess engineering; and respirator design and prototyping. The center also conducts R&D on smoke/obscurant equipment. This federal facility annually receives about \$144 million of federal R&D funds, approximately \$52 million of which is spent on in-house activities, and has about 830 civilian personnel, only a portion of whom are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The U.S. Army Medical Research Institute of Chemical Defense is a unit of DOD. It develops medical countermeasures for use against chemical warfare agents. Specifically, the institute conducts research on medical defense against agents (neurotoxins) of biological origin. It also has a clinical training mission, teaching health care providers from all the armed services how to manage chemical casualties. This federal facility annually receives about \$26 million of federal R&D funds, approx-

imately \$19 million of which is spent on in-house activities, and has about 150 civilian personnel, virtually all of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

- The U.S. Army Materiel Systems Analysis Activity is a unit of DOD. It employs automated databases and models to characterize the functionality of Army materiel systems. It has developed unique models and methodologies to accurately predict critical performance variables, such as weapon accuracy, target acquisition, rate of fire, probability of inflicting catastrophic damage, and system reliability. It is also responsible for ensuring their standard use across Army and joint service studies. This federal unit annually receives about \$12 million of federal R&D funds, virtually all of which is spent on in-house activities, and has about 275 civilian personnel, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Aberdeen Proving Ground is a unit of DOD's Army Research Laboratory. The laboratory is headquartered in Adelphi, Maryland, with additional sites in White Sands, New Mexico; Cleveland, Ohio; Hampton, Virginia; Eatontown, New Jersey; and Atlanta, Georgia. The laboratory's Directorate of Corporate Information and Computing, Directorate of Human Research and Engineering, Directorate of Survivability/Lethality Analysis, and Directorate of Weapons and Materials Technology are headquartered in Aberdeen. These directorates conduct research on the ballistics of projectiles, guns, and missiles; propulsion technology; munition lethality; armor protection; munition survivability; materials for armor, antiarmor, and soldier protection; soldier/machine interface; human interaction with military systems; networking and telecommunications; scientific visualization; and high-performance computing. Specific areas of research interest include theoretical mechanics, physics,

pulsed electromagnetic power, polymers, adhesives, composite materials, robotics, and computer-aided design. This unit annually receives about \$220 million of federal R&D funds, approximately \$93 million of which is spent on in-house activities, and employs about 953 civilians, only a portion of whom are directly involved in R&D activities.

- The Firing Tables Branch is a unit of the Army's Armament Research, Development, and Engineering Center inside DOD. The center is headquartered in Picatinny, New Jersey, with subordinate research activities in Rock Island, Illinois; Watervliet, New York; and Aberdeen, Maryland. The center's focus is on integrating complex armament technologies into guns, ammunition, and fire control systems through research, development, acquisition, and sustainment. This branch conducts research on aeroballistic design, with a particular focus on the development of aiming and ballistic fire control data for all unguided and some guided combat weapon systems. This federal unit annually receives approximately \$980,000 of federal R&D dollars for in-house activities and has about 60 civilian personnel, only a portion of whom are involved in R&D activities.

Adelphi, Maryland, is home to a unit of DOD's Army Research Laboratory.

- The Adelphi Laboratory Center is the headquarters unit of DOD's Army Research Laboratory. The laboratory also has sites in Aberdeen, Maryland; White Sands, New Mexico; Cleveland, Ohio; Hampton, Virginia; Eatontown, New Jersey; and Atlanta, Georgia. The laboratory's Directorate of Information Science and Technology and Directorate of Sensors and Electron Devices are headquartered at the Adelphi Center. It conducts basic and applied research to provide the Army with the key technologies and analytical support necessary to ensure supremacy in future land warfare. Its research areas include flame chemistry, aerodynamics, transonic experimentation, properties of tungsten alloys, explosives mechanics, aircraft vulnera-

bility, robotics, composites, materials, electro-optics, ion implantation, sensors, and acoustics. This federal unit annually receives approximately \$188 million of federal R&D funds, \$79 million of which is spent on in-house activities, and has about 864 civilian personnel, all of whom are involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Baltimore, Maryland, is home to the Department of Interior's (DOI) Maryland District Office of Water Resources and a Department of Veterans Affairs (DVA) R&D unit.

- The Maryland District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.3 million in federal R&D funds.
- While the principal focus of the Baltimore VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 473 projects with total funding of approximately \$5.9 million. These R&D ac-

tivities focus on a wide range of topics, including congestive heart failure, hypertension, drug therapy, arrhythmia, electric countershock, and neoplasms.

Beltsville, Maryland, is home to USDA's Beltsville Agricultural Research Center.

- The Beltsville Agricultural Research Center (BARC) is a unit of USDA's Agricultural Research Service (ARS) located on the campus of the University of Maryland. It consists of four research divisions focusing on plant science, livestock and poultry science, human nutrition, and natural resources. Specifically, the Plant Science Institute conducts research on developing environmentally safe ways of controlling undesirable plants through the use of conventional crop protection chemicals, biologically based approaches to controlling weeds and the development of alternative weed management systems for sustainable agriculture. The Livestock and Poultry Science Institute conducts research to increase production efficiency and quality of livestock products and consists of nine laboratories and three service divisions. The Beltsville Human Nutrition Research Center conducts research to better understand the relationship between diet and health. Specific research activities of this center focus on the role of food and its components in optimizing human health and in reducing the risk of nutritionally related disorders in the diverse population. The Natural Resources Institute conducts research in different areas, including water quality, climate change, food quality and safety, sustainable agriculture, and controlled release of genetically engineered microorganisms. This federal R&D unit annually receives approximately \$123 million of federal R&D funds and has about 1,300 FTEs.

Bethesda, Maryland, is home to the HHS's National Institutes of Health and DOD's Naval Medical Research Institute and Armed Forces Radiobiology Research Institute.

- The National Institutes of Health (NIH) is a unit of HHS. NIH is a major medical research organization, supporting projects

conducted throughout the nation on cancer, Alzheimer's disease, diabetes, arthritis, heart disease, AIDS, and virtually every other human ailment and condition. NIH consists of 18 separate institutes, three centers, a handful of special project offices, and a library, virtually all of which are in Bethesda. Specifically, NIH includes the National Cancer Institute; the National Heart, Lung, and Blood Institute; the National Institute of Allergy and Infectious Diseases; the National Institute of General Medical Sciences; the National Institute of Diabetes and Digestive and Kidney Diseases; the National Institute of Neurological Disorders and Stroke; the National Institute of Mental Health; the National Institute of Child Health and Human Development; the National Institute on Drug Abuse; the National Institute on Aging; the National Eye Institute; the National Institute of Arthritis and Musculoskeletal and Skin Diseases; the National Institute on Alcohol Abuse and Alcoholism; the National Institute of Dental and Craniofacial Research; the National Institute on Deafness and Other Communication Disorders; the National Human Genome Research Institute; and the National Institute of Nursing Research. Co-located with these institutes are the National Center for Complementary and Alternative Medicine, the Fogarty International Center, the National Center for Research Resources, the Office of AIDS Research, the National Library of Medicine, and the Office of the Director, which contains the Offices of Research on Minority Health and the Minority Health Initiative, Research on Women's Health, Behavioral and Social Sciences Research, and Disease Prevention. The National Institute of Environmental Health Sciences is located in Research Triangle Park, North Carolina. In addition, special NIH laboratories are located in Phoenix, Arizona, and Hamilton, Montana. This federal R&D unit annually receives over \$15 billion of federal R&D funds, approximately \$1.6 billion of which is spent in Maryland to employ about 16,000 people on-site at the NIH facilities. The vast majority of these people work in NIH's laboratories, conducting the more than 2,000 research projects each year. Others are involved in

making approximately \$13.4 billion of federal R&D awards to colleges, universities, and other eligible institutions across the nation to support R&D projects at their campuses and facilities.

- The Naval Medical Research Institute is a unit of DOD. It conducts basic and applied research on infectious diseases, tissue transplantation, diving and hyperbaric medicine, casualty care, and environmental medicine and human factors directly related to military requirements and operational needs. The institute's R&D is specifically designed to enhance the health, safety, and readiness of Navy and Marine Corps personnel in the effective performance of peacetime and contingency missions. This federal unit annually receives about \$16.5 million of federal R&D funds, approximately \$12.4 million of which are spent on in-house activities, and has about 145 civilian personnel.
- The Armed Forces Radiobiology Research Institute is a unit of DOD. It conducts research in the field of radiobiology and related matters essential to the operational and medical support of the military services. The specific R&D activities of the institute include biological and biophysical dosimetry, health effects of embedded depleted uranium, nuclear-biological-chemical interactions and countermeasures, and radiation casualty management. This federal unit annually receives a total of about \$11 million of federal R&D funds, all of which is spent on in-house activities, and has about 101 civilian personnel.

Bowie, Maryland, is home to a unit of DOD's Institute for Defense Analyses Communications and Computing Federally Funded Research and Development Center (FFRDC).

- The Center for Computing Sciences is one of three units constituting the Institute for Defense Analyses Communications and Computing FFRDC. This FFRDC, which is nominally headquartered in Alexandria, Virginia, is sponsored by DOD's National Security Agency and operated by the Institute for Defense Analyses. It conducts R&D in such areas as parallel processing, network security, signal processing, discrete and continuous

optimization, and symbolic computation. In addition to the center in Bowie, it has two Centers for Communications Research located in Princeton, New Jersey, and La Jolla, California. The three units of this federally owned and contractor-operated R&D center together annually receive approximately \$35 million of core funding, all of which is federal R&D funds, and have about 150 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Camp Springs, Maryland, is home to DOC's National Environmental Satellite, Data, and Information Service Office of Research and Applications.

- The National Environmental Satellite, Data, and Information Service Office of Research and Applications is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). The office contains three divisions—the Atmospheric Research and Applications Division, the Climate Research and Applications Division, and the Oceans Research and Applications Division—in Camp Springs. The R&D activities of all three divisions are focused on developing forecasting models for predicting changes in the atmosphere, climate, and oceans. This federal unit annually receives approximately \$8 million of federal R&D funds and has about 85 employees.

Carderock, Maryland, is home to the DOD's Naval Surface Warfare Center Carderock Division.

- The Naval Surface Warfare Center Carderock Division is a unit of DOD. It conducts R&D on hydrodynamics, propulsor acoustic and nonacoustic signatures, ship signatures, ship structures and protection, aerodynamics, logistics, mathematics, and systems engineering. This federal unit annually receives approximately \$181 million of federal R&D funds for in-house activities and has about 3,769 civilian personnel, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Chesapeake Beach, Maryland, is home to DOD's Naval Research Laboratory Chesapeake Bay Detachment.

- The Chesapeake Bay Detachment is a unit of DOD's Naval Research Laboratory. It conducts R&D on radar, electronic warfare, optical devices, materials, communications, and fire at its 169-acre campus on the Chesapeake Bay. The funding and staffing figures for the detachment are modest and are included in those for the main laboratory in the District of Columbia.

Edgewater, Maryland, is home to the Smithsonian Institution's Environmental Research Center.

- The Environmental Research Center is a unit of the Smithsonian Institution. It conducts research on the biological and physical processes that sustain life on earth. Specifically, the center examines linked ecosystems, especially those affected by human activities, in search of the mechanisms that regulate the structure and dynamics of the environment. The center annually receives approximately \$2.5 million of federal R&D funds and has about 45 FTEs, the vast majority of whom are involved in R&D activities.

Frederick, Maryland, is home to DOD's Medical Research Institute of Infectious Diseases, USDA's Foreign Disease-Weed Science Research Unit, and HHS's Frederick Cancer Research and Development Center.

- The Army Medical Research Institute of Infectious Disease is a unit of DOD. It conducts research to develop strategies, products, information, procedures, and training programs for medical defense against biological warfare threats and naturally occurring infectious diseases that require special containment. Specific research areas include the development of medical countermeasures, such as vaccines, therapeutic drugs, diagnostic capabilities, and various medical management procedures, to protect military personnel against biological attack. The institute is the only biological containment laboratory in DOD for the study of hazardous diseases. This federal facility annually re-

ceives about \$29 million of federal R&D funds, virtually all of which are spent on in-house activities, and has about 197 civilian personnel.

- The Foreign Disease-Weed Science Research Laboratory is a unit of USDA's ARS. It conducts research on new or emerging plant pathogens that are not yet established in the United States and that must be kept under containment. Specific research activities of the laboratory include the identification and control of pathogens that pose a potential threat to American agriculture and the use of foreign pathogens for biological control of introduced weeds. The overall goal of the unit's weed research is to support sustainable agriculture by helping American agriculture eliminate its reliance on chemicals for control of weeds. This federal R&D unit annually receives approximately \$2.5 million of federal R&D funds and has about 27 FTEs.
- The Frederick Cancer Research and Development Center is an FFRDC sponsored by NIH's National Cancer Institute and operated jointly by three contractors—Charles River Laboratories, Data Management Services, Inc., and SAIC Frederick, a division of Science Applications International Corporation. The center conducts research on the causes of cancer and related diseases. The center provides research support for NCI's intramural programs, including clinical trials, vaccine development, and biomedical applications of supercomputing. This federally owned and contractor-operated facility has, in recent years, annually received an average of around \$140 million of core funding and employed a staff of approximately 1,200 people.

Gaithersburg, Maryland, is home to DOC's National Institute of Standards and Technology.

- The National Institute of Standards and Technology (NIST) is a unit of DOC. It conducts research to develop measurements and set standards in its seven laboratories. NIST's Building and Fire Research Laboratory (BFRL) studies building materials; computer-integrated construction practices; fire science and fire

safety engineering; and structural, mechanical, and environmental engineering. The results of BFRL's research include measurements and test methods, performance criteria, and technical data that support innovations by industry and are incorporated into building and fire standards and codes. This federal R&D facility annually receives approximately \$21 million of federal R&D funds and has about 108 FTEs. NIST's Chemical Science and Technology Laboratory (CSTL) conducts R&D on the chemical, biomolecular, and chemical engineering measurements, data, models, and reference standards required to enhance U.S. industrial competitiveness in the world market. The research areas of CSTL include analytical chemistry, surface chemistry and microanalysis, process measurements and modeling, and biotechnology. This federal R&D facility annually receives approximately \$32 million of federal R&D funds and has about 242 FTEs. NIST's Electronics and Electrical Engineering Laboratory (EEEL) provides the basis for all electrical measurements in the United States; practical measurement methods for the electronics, optoelectronics, and electrical industry sectors; and advertised calibration services. All of EEEL's R&D activities are conducted to advance the state of the art of electrical and electronic measurement. This federal R&D facility annually receives approximately \$36 million of federal R&D funds and has about 269 FTEs. NIST's Information Technology Laboratory (ITL), formerly known as the Computer Science and Applied Mathematics Laboratory, conducts objective, neutral tests for information technology. Specifically, ITL works with industry and government organizations to develop and demonstrate tests, test methods, reference data, proof-of-concept implementations, and other infrastructural technologies. This federal R&D facility annually receives approximately \$42 million of federal R&D funds and has about 327 FTEs. NIST's Manufacturing Engineering Laboratory (MEL) serves as a central research laboratory for manufacturing infrastructure technology, measurements, and standards. MEL research provides industry-needed manufacturing engineering tools, interface stan-

dards, manufacturing systems architectures, and traceability. This federal R&D facility annually receives approximately \$18 million of federal R&D funds and has about 156 FTEs. NIST's Materials Science and Engineering Laboratory (MSEL) is focused on developing the measurement and standards infrastructure related to material critical to U.S. industry. Separate research initiatives of MSEL address ceramics, metals, polymers, composites, superconductors, and the theory and modeling of materials structure and performance. This federal R&D facility annually receives approximately \$41 million of federal R&D funds and has about 362 FTEs. NIST's Physics Laboratory develops new measurement methods and instruments for overcoming measurement barriers to accuracy, reliability, and manufacturability. This research is a vital component of the nation's technology infrastructure, providing highly specialized services that support innovation and industrial progress. This federal R&D facility annually receives approximately \$27 million of federal R&D funds and has about 191 FTEs. Altogether, NIST annually spends approximately \$235 million of federal R&D funds on in-house R&D activities and has about 2,047 FTEs involved in R&D or R&D support activities.

Greenbelt, Maryland, is home to NASA's Goddard Space Flight Center.

- The Goddard Space Flight Center is a unit of NASA. It conducts research in Earth science, space science, and technology. The center's Earth Observing System is the centerpiece of NASA's Earth Science Enterprise. This system consists of science and data systems that support a coordinated series of polar-orbiting and low-inclination satellites for long-term global observations of the land surface, biosphere, solid Earth, atmosphere, and oceans. The center's research in this area will advance understanding of the Earth as an environment system by determining how its components have developed, how they function, how they interact, and how they evolve on various time scales. The center is also committed to the development of cutting-edge technology by advancing next-generation space-

craft, sensor, and instrument technology. This federal facility annually receives a total of about \$2.5 billion, at least \$2 billion of which directly involves R&D efforts. The center has about 3,338 FTEs, only a portion of whom are involved in R&D activities. Approximately \$120 million of these funds and about 256 of these employees are located at the Wallops Flight Facility in Wallops Island, Virginia. Another \$9 million of these funds and about 150 of these employees are located at the Goddard Institute for Space Studies in New York, New York. A substantial portion of its funds is spent on the maintenance and operation of R&D equipment and facilities. In a recent year, the center awarded over \$920 million of R&D contracts, about \$330 million of which were made to entities based in Maryland.

Indian Head, Maryland, is home to the Naval Surface Warfare Center Indian Head Division.

- The Naval Surface Warfare Center Indian Head Division is a unit of DOD. It conducts R&D on explosive and propellant devices in the areas of chemistry, physics, and engineering using laboratory studies, computer simulations, and testing and mixing facilities. Specific R&D activities of this unit focus on such areas as energetic systems; material development, testing, and evaluation (including ordnance explosives, explosive leads, squibs, detonators, and propellants); detonation science; manufacturing technology; underwater warheads; explosives packaging, handling, storage, and transportation technology; chemical processing/nitration; nitramine gun and high-energy propellants; cartridge-actuated devices/propellant-actuated devices; explosive safety standards; and ordnance environmental protection. This federal unit annually receives approximately \$49 million of federal R&D funds for in-house activities and has about 2,135 civilian personnel, only a portion of whom are involved in R&D activities.

Lexington Park, Maryland, is home to DOD's Naval Research Laboratory Flight Support Detachment.

- The Flight Support Detachment is a unit of DOD's Naval Research Laboratory. It maintains several modified turboprop airplanes at the Naval Air Station in Lexington Park for use as airborne research platforms. Among the R&D activities under way at the detachment are ones focusing on measuring and mapping the Earth's magnetic variations, as well as ones involving bathymetry, electronic countermeasures, gravity mapping, and radar. The funding and staffing for the detachment are modest and are included those for the main laboratory the District of Columbia.

Oxford, Maryland, is home to DOC's Center for Coastal Fisheries and Habitat Research.

- The Center for Coastal Fisheries and Habitat Research is a part of the Beaufort/Oxford Laboratory inside DOC's NOAA. While most of the laboratory's activities take place in North Carolina, a small center is located on Maryland's Eastern Shore. This latter center conducts research on oyster diseases, habitat restoration, and protection of marine mammals and sea turtles. The funding and staffing figures for this center are included in those for the Beaufort/Oxford Laboratory in Beaufort, North Carolina.

Patuxent River, Maryland, is home to a unit of DOD's Naval Air Warfare Center Aircraft Division.

- The Naval Air Warfare Center Aircraft Division is a unit of DOD. It is headquartered in Patuxent, with activities at an additional site in Lakehurst, New Jersey. It conducts R&D on aircraft systems; shipboard, fixed, and mobile communications; and information technology systems. This federal unit annually receives approximately \$318 million of federal R&D funds and has about 2,300 civilian personnel, only a portion of whom are involved in R&D activities. A substantial portion of these

funds is spent on the maintenance and operation of R&D equipment and facilities.

Princess Anne, Maryland, is home to DOI's Maryland Cooperative Fish and Wildlife Unit and Patuxent Wildlife Research Center.

- The Maryland Cooperative Fish and Wildlife Unit is part of DOI's USGS. It is on the campus of the University of Maryland, Eastern Shore. It conducts research on the effects of current or potential environmental changes or perturbations on fish and wildlife resources. Specific research activities of this unit include studying aquaculture and fish physiology, fisheries and aquatic ecology, fish health and pathology, and wildlife and terrestrial ecology. This federal R&D unit annually receives approximately \$322,000 of federal R&D funds and has about four FTEs.
- The Patuxent Wildlife Research Center is a unit of DOI's USGS. It conducts research on understanding and addressing national and regional natural resource problems—from establishing inventories, identifying resource issues, and testing hypotheses through monitoring and evaluation programs. Specific research activities of this center include developing and managing national inventory and monitoring programs and the North American Bird Banding Program. This federal R&D unit annually receives approximately \$7.6 million of federal R&D funds and has about 137 FTEs.

Rockville, Maryland, is home to four centers of HHS's Food and Drug Administration.

- The Food and Drug Administration (FDA) is a unit of HHS that is headquartered in Rockville. The FDA is responsible for ensuring that foods, drugs, medical devices, biological products, cosmetics, and radiation-emitting electronic products are safe and effective. While the majority of FDA's activities focus on enforcing the federal Food, Drug, and Cosmetics Act and related public health laws, the FDA must conduct research to set the

basic standards required by these laws and to assess the safety and efficacy of the various products that it oversees. The FDA consists of six centers, four of them in Rockville, with ancillary units in Bethesda and Beltsville. The Centers for Biologics Evaluation and Research, Devices and Radiological Health, Drug Evaluation and Research, and Veterinary Medicine are located here. The Center for Food Safety and Applied Nutrition is in Washington, D.C., and the National Center for Toxicological Research is in Jefferson, Arkansas. FDA's Center for Biologics Evaluation and Research is responsible for ensuring the safety and effectiveness of biological and related products, including blood, vaccines, and biological therapeutics. This federally owned and operated facility has a total annual budget of approximately \$123 million, about \$22.4 million of which is federal R&D funds. The center has about 1,000 FTEs, approximately 200 of which are directly involved in research activities. FDA's Center for Devices and Radiological Health is responsible for ensuring the safety and effectiveness of medical devices and eliminating unnecessary human exposure to man-made radiation from medical, occupational, and consumer products. This federally owned and operated facility has a total annual budget of approximately \$155 million, about \$6.7 million of which is federal R&D funds. The center has about 1,550 FTEs, approximately 70 of whom are directly involved in R&D activities. FDA's Center for Drug Evaluation and Research ensures the availability of safe and effective drugs. This federally owned and operated facility has a total annual budget of approximately \$262 million, about \$8.4 million of which is federal R&D funds. The center has about 2,400 FTEs, approximately 100 of whom are directly involved in R&D activities. FDA's Center for Veterinary Medicine is responsible for ensuring that animal drugs and medicated feeds are safe and effective for their intended uses and that food from treated animals is safe for human consumption. This federally owned and operated facility has a total annual budget of approximately \$41 million, about \$7.1 million of which is federal R&D funds. The center

has about 390 FTEs, approximately 53 of whom are directly involved in R&D activities.

Silver Spring, Maryland, is home to DOC's Hydrologic Research Laboratory, Advanced Development and Demonstration Laboratory, Integrated Systems Laboratory, Techniques Development Laboratory, Air Resources Laboratory, and Geosciences Research Division.

- The Hydrologic Research Laboratory is unit of DOC's NOAA. It conducts research on flood and water resource forecast systems in field operations to support weather prediction activities. It also provides support for the implementation of hydrology-related components of major weather-prediction systems, such as the Doppler weather surveillance radar and the Advanced Weather Interactive Processing System. This federal unit annually receives approximately \$2.6 million of federal R&D funds and has about 18 FTEs.
- The Advanced Development and Demonstration Laboratory is a unit of DOC's NOAA. It defines, plans, and initiates development of advanced functional capabilities required to modernize and restructure the National Weather Service. Specifically, the laboratory plans for the timely introduction of new functional capabilities within the modernized systems architecture to respond to evolving requirements and emerging scientific opportunities and to avoid costly technological obsolescence. It is responsible for providing government-developed software to the Advance Weather Interactive Processing System. This federal unit annually receives approximately \$1.7 million of federal R&D funds and has about 12 FTEs.
- The Integrated Systems Laboratory is a unit of DOC's NOAA. It develops, demonstrates, and integrates systems and system improvements required for weather warning and forecasting operations. As the repository for engineering, computer science, and the state-of-the-art technical expertise on embedded weather system planned and operational systems, the laboratory is responsible for in-house design and development efforts requiring

such expertise. This federal unit annually receives approximately \$1.1 million of federal R&D funds and has about 11 FTEs.

- The Techniques Development Laboratory is a unit of DOC's NOAA. It conducts or sponsors applied R&D to improve diagnostic and prognostic weather information for use in making official weather forecasts. It carries out studies to improve the prediction methodology used by the National Weather Service. It gives special emphasis to developing improved methods for predicting tornadoes, severe local storms, and abnormal water levels caused by hurricanes. This federal unit annually receives approximately \$4.0 million of federal R&D funds and has about 49 FTEs.
- The Air Resources Laboratory is a unit of DOC's NOAA. It studies climate and air quality, turbulence and diffusion in the atmosphere, global transport of pollutants, the meteorology of air pollution, air-surface exchange, and global climate change. This federal R&D unit annually receives approximately \$3.7 million of federal R&D funds and has about 113 FTEs.
- The Geosciences Research Division, formerly known as the Geosciences Laboratory, is a unit of DOC's NOAA. It conducts research on the standards for conducting geodetic surveys and assists in the development of surveying instruments and procedures. This federal R&D unit annually receives approximately \$3.3 million of federal R&D funds and has about 20 employees.

Suitland, Maryland, is home to the Smithsonian Institution's Center for Materials Research and Education.

- The Center for Materials Research and Education is a unit of the Smithsonian Institution. This specialized research facility is dedicated to the technical study and conservation of museum artifacts and their components. It also advises and assists the Smithsonian and other museums in the study, preservation, and conservation of artistic and historic objects. It conducts re-

search in the areas of material technology, chemistry, art and cultural history, and development of treatment procedures. The center conducts programs that include basic and advanced conservation training and provides various opportunities for the increase and diffusion of knowledge about conservation to museums and associated professionals throughout the United States and the world. This federal R&D unit annually receives approximately \$3 million of federal R&D funds and employs about 36 FTEs, all of whom are involved in R&D activities.

White Oak, Maryland, is home to a unit of DOD's Arnold Engineering Development Center.

- The Arnold Engineering Development Center is a national aerospace ground test center headquartered at Arnold Air Force Base, Tennessee. It conducts R&D on propulsion, aerodynamic, reentry, transatmospheric, and space-flight systems. The center also conducts research to develop new test capabilities, facilities, and technologies for future simulated flight-testing. Its hypervelocity wind tunnel test facility is located in White Oak. This latter federal unit annually receives approximately \$845,000 of federal R&D funds and employs about 23 civilians.

FEDERAL R&D GRANTS TO MARYLAND ENTITIES

Every major institution of higher education in Maryland is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Johns Hopkins University, the University of Maryland, and Morgan State University. The table below shows the total number of R&D grants that were active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. The grants in the "Other Agencies" category going to Johns Hopkins come equally from

DOE, the EPA, and the Department of Education. The comparable grants going to U of Maryland include \$8 million from DOE, \$6 million each from USDA and DOC, and \$3 million from EPA.

Table 21.1 – Sources of Federal R&D Grants to Higher Education in Maryland

Institution	HHS		NSF		DOD		NASA		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Johns Hopkins	\$304M	1,141	\$13M	212	\$7M	60	\$6M	119	\$6M	46	\$336M	1,578
U of Maryland	\$92M	462	\$26M	440	\$12M	74	\$14M	251	\$23M	261	\$167M	1,488
Morgan State	\$2M	5	<\$1M	1	\$1M	3	\$1M	10	\$1M	3	\$5M	22
Other	\$2M	9	\$1M	18	0	0	<\$1M	10	\$1M	7	\$3M	44
Total	\$400M	1,617	\$40M	671	\$19M	137	\$22M	390	\$30M	317	\$511M	3,132

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Johns Hopkins School of Medicine.

Several other nonacademic institutions in Maryland also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Social and Scientific Systems, Inc., in Bethesda (\$26 million), the Henry M. Jackson Foundation for the Advancement of Military Medicine in Rockville (\$15 million), Advanced Bioscience Laboratories in Rockville (\$14 million), and the Institute for Genomic Research in Rockville (\$9 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Maryland received 202 SBIR awards totaling \$53 million.

Examples include a \$1 million award from DOD (Ballistic Missile Defense Organization) to Genex Technologies, Inc., in Rockville for development of an omnidirectional 3-D camera for battlefield modeling and a \$400,000 award from NSF to Blazie Engineering, Inc., in Forest Hill to design a new and improved print-reading machine for the blind.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Maryland are ones valued at more than \$3.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Maryland every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MARYLAND

Several entities in Maryland also receive notable sums of federal R&D dollars in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the largest recipient of R&D contracts in FY 1998 was Johns Hopkins for work at its Applied Physics Laboratory. It received more than \$400 million collectively from federal agencies, with the largest contributor by far being DOD. In addition, a large portion of federal R&D contract funds went to Lockheed Martin Corporation (\$225 million), primarily for the Joint Strike Fighter Concept Demonstration Program. In addition, Westat Inc. (\$172 million), the Association of Universities for Research (\$116 million), Raytheon Company (\$95 million), and Northrop Grumman (\$94 million) received large R&D contracts from federal agencies in FY 1998. The contract to the Association of Universities for Research noted above is for the operation of NASA's Hubble Space Telescope.

The University of Maryland (\$28 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, generally they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$60 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities located in Maryland. By far the largest of these cooperative agreements (\$33 million) came from DOD to the Henry M. Jackson Foundation for the Advancement of Military Medicine in Rockville for its HIV Research program. Other federal agencies awarding cooperative agreements to Maryland-based entities include DOE, DOC, and NSF. Among these latter cooperative agreements are awards are two of NSF's Materials Research Science and Engineering Centers—the Center for Oxide Thin Films, Probes, and Surfaces at the University of Maryland, College Park, and the Center for Nanostructured Materials at Johns Hopkins University.

Chapter 22

Federal Research and Development in Massachusetts

- Approximately \$3.6 billion of federal R&D funds are spent each year in Massachusetts.
- Massachusetts ranks 6th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 22 percent of all federal funds spent in Massachusetts each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

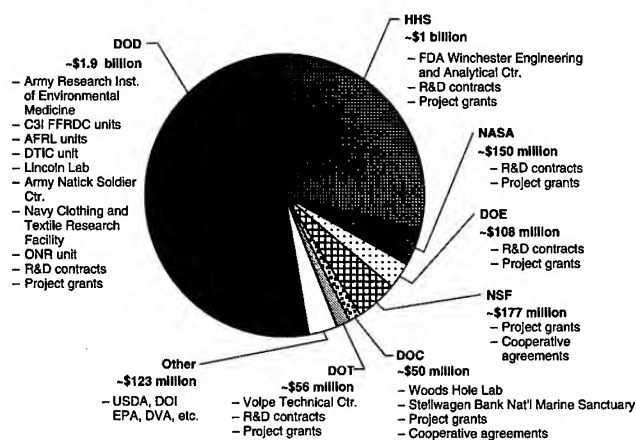


Figure 22.1 – Sources of Federal R&D Dollars Spent in Massachusetts
(Total Federal R&D ~\$3.6 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$3.6 billion annually in Massachusetts on research and development (R&D) activities. On average, federal R&D dollars account for approximately 22 percent of all federal funds spent in Massachusetts each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Massachusetts. Foremost among these agencies is the Department of Defense (DOD), which accounts for 53 percent of all federal R&D dollars spent in the state. The Department of Health and Human Services (HHS) accounts for 29 percent of the federal R&D dollars spent in Massachusetts, while the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) account for an additional 5 and 4 percent, respectively. The remaining federal R&D dollars come collectively from the Departments of Agriculture (USDA), Commerce (DOC), Energy (DOE), Interior (DOI), and Transportation (DOT) and several other federal agencies.²²

All federal R&D dollars spent in Massachusetts either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Massachusetts.

FEDERAL R&D UNITS IN MASSACHUSETTS

Amherst, Massachusetts, is home to DOI's Massachusetts Cooperative Fish and Wildlife Research Units and a unit of USDA's Northeastern Research Station.

²² For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

- The Massachusetts Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the Amherst campus of the University of Massachusetts. It conducts research on fishery ecology, wildlife populations, and natural resources. Specific research activities of this unit include evaluating wildlife population models and researching anadromous fish ecology. This federal R&D unit annually receives approximately \$200,000 of federal R&D funds and has about three FTEs.
- The R&D Work Site is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on the ecological factors affecting U.S. forests. Specific research activities of this unit have focused on the relationship between small-mammal communities in forests and breeding bird communities in forests. This federal R&D unit annually receives approximately \$1.1 million of federal R&D funds and has about five employees.

Bedford, Massachusetts, is home to DOD's Command, Control, Communications, and Intelligence Federally Funded Research and Development Center (FFRDC) and a Department of Veterans Affairs (DVA) R&D unit.

- The Command, Control, Communications, and Intelligence FFRDC is sponsored by the Office of the Secretary of Defense and operated by the MITRE Corporation. It conducts R&D on command, control, communications, and intelligence systems for DOD and the intelligence community. The center has three divisions, the Center for Air Force Integrated Intelligence Systems, the Center for Integrated Intelligence Systems, and the C3 Center. This latter division is in McLean, Virginia. The first division provides the Air Force, most especially the Electronic Systems Center, with comprehensive command and control knowledge, expertise, and experience. The R&D activities of the second division focus on developing concepts for intelligence activities, enhancing architectures for information man-

agement, and engineering intelligence systems. The combined divisions of this federally owned and contractor-operated facility annually receive about \$180 million of federal R&D funds and employ approximately 1,450 people.

- While the principal focus of the Edith Nourse Rogers Memorial Veterans Hospital, the VA Medical Center in Bedford, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 85 projects with total funding of approximately \$4 million. These R&D activities focus on a wide range of topics, including chronic disease epidemiology, cardiovascular disease, cancer, pulmonary disease, mental health, hematology, gastrointestinal disease, hypertension, diabetes, and genetics.

Boston, Massachusetts, is home to a part of DOD's Air Force Research Laboratory Space Vehicles Directorate, a part of Air Force Research Laboratory Sensors Directorate, a unit of the Office of Naval Research, and a regional office of the Defense Technical Information Center; USDA's Human Nutrition Research Center on Aging; DOI's North Atlantic Field Station; and a DVA R&D unit.

- The Space Vehicles Directorate at Hanscom Air Force Base is a unit of DOD's Air Force Research Laboratory. It is headquartered in Albuquerque, New Mexico. This unit conducts R&D on exploiting and controlling space. This federal unit annually receives approximately \$27 million of federal R&D funds, only about 11 percent of which is spent on in-house R&D activities, and has about 239 civilian personnel, only a portion of whom are involved in R&D activities.
- The Sensors Directorate Electromagnetics Technology Division at Hanscom Air Force Base is a unit of DOD's Air Force Research Laboratory. The directorate is headquartered in Dayton, Ohio, with another site in Rome, New York. This division conducts R&D to meet Air Force needs for air, space, and command and control applications in electromagnetics, related elec-

tronic and electro-optics, and information security technologies. In addition, it conducts R&D on the entire electromagnetic spectrum from deep ultraviolet to microwaves to address the growing needs of warfighters for cost-effective performance options. This federal unit annually receives approximately \$9 million of federal R&D funds, only about 28 percent of which is spent on in-house R&D activities, and has about 108 civilian personnel, only a portion of whom are involved in R&D activities.

- The R&D Management Command is a unit of the Office of Naval Research (ONR) inside DOD. ONR is headquartered in Arlington, Virginia, and provides R&D managers to oversee the extramural R&D programs of the Navy and Marine Corps performed at universities, nonprofit organizations, or for-profit companies. ONR sponsors extramural R&D programs in information, electronics, and surveillance; ocean, atmosphere, and space; engineering, materials, and physical science; human systems; and naval expeditionary warfare. This federal unit annually receives approximately \$792,000 of federal R&D funds to support the in-house management activities of about 17 FTEs.
- The Northeastern Regional Office of the Defense Technical Information Center (DTIC) contributes to the R&D efforts by providing access to and facilitating the exchange of scientific and technical information. Specifically, DTIC concentrates on providing information on planned, ongoing, and completed DOD-related R&D to federal agencies and their contractors. This federal unit annually receives approximately \$150,000 of federal R&D funds and employs about two people, only one of whom is involved in R&D activities.
- The Human Nutrition Research Center on Aging (HNRC) is a unit of USDA's Agricultural Research Service (ARS). It conducts research on the influence of nutrition on the aging process. Specific research activities of this center include studies of the influences of nutrition on tissue loss, the role of nutrition in the

genesis of chronic degenerative conditions, and the nutritional requirements necessary to maintain optimal well-being of an older person. This federal R&D unit receives approximately \$15.1 million of federal R&D funds and has about 14 FTEs.

- The North Atlantic Field Station is a unit of the Patuxent Wildlife Research Center inside DOI's USGS. It conducts research on and surveys of the Massachusetts shoreline. Specific research activities of this unit include obtaining field data required to develop and implement a numerical model of circulation within the Nauset estuary and Cape Cod National Seashore and studying the flushing rate of Town Cove to assess the limits on groundwater-delivered nutrients and their affects on the estuary. This federal R&D unit receives approximately \$92,000 in federal R&D funds and has one FTE.
- While the principal focus of the Boston VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 273 projects with total funding of approximately \$9.7 million. These R&D activities focus on a wide range of topics, including behavioral toxicology, cancer epidemiology, behavioral psychopathology, and immunotoxicology. One particularly noteworthy research project of the center focused on the neurological function in veterans suffering from environmental exposures.

Brockton, Massachusetts, is home to a DVA R&D unit.

- While the principal focus of the Brockton VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 236 projects with total funding of approximately \$4.4 million. These R&D activities focus on a wide range of topics, including understanding the pathophysiology, clinical characteristics, and treatment of schizophrenia.

Cambridge, Massachusetts, is home to DOT's John A. Volpe National Transportation Systems Center and the Smithsonian Institution's Astrophysical Observatory.

- The John A. Volpe National Transportation Systems Center is a unit of DOT's Research and Special Programs Administration. It conducts research on accident prevention, acoustics measurement, GPS applications, and surveillance and sensors technology. Specific R&D activities of the center include assessing the use of GPS for highway vehicles; evaluating GPS outage reporting systems for civilian and military aviators; developing and improving various types of meteorological sensors for airport applications; and developing sensors for the detection, tracking, and characterization of aircraft wake turbulence. The Volpe Center is not directly funded under the federal budget. Instead, the center relies totally on fee-for-service payments to support its operations. Nevertheless, over two-thirds of the center's R&D activities are funded by DOT and other federal agencies.
- The Astrophysical Observatory, part of the Smithsonian Institution, conducts research in astronomy, astrophysics, and Earth and space sciences in close coordination with the observatory at Harvard. This research, while interrelated and complementary, is organized according to the following divisions: atomic and molecular physics, high-energy astrophysics, optical and infrared astronomy, planetary sciences, radio and geoastronomy, solar and stellar physics, and theoretical astrophysics. Observational data are gathered by instruments aboard rockets, balloons, and spacecraft, as well as by ground-based telescopes at the Fred Lawrence Whipple Observatory in Arizona and the Oak Ridge Observatory in Massachusetts, and by a millimeter-wave radio telescope in Cambridge. The observatory annually receives approximately \$16.5 million of federal R&D funds and has about 141 FTEs, an estimated two-thirds of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Lexington, Massachusetts, is home to DOD's Lincoln Laboratory.

- Lincoln Laboratory is an FFRDC sponsored by the Air Force and operated by the Massachusetts Institute of Technology. It conducts R&D on communications, space surveillance, missile defense, tactical surveillance systems, air traffic control, and air defense. This federally owned and contractor-operated unit annually receives approximately \$370 million of federal R&D funds and has about 2,500 civilian personnel.

Natick, Massachusetts, is home to DOD's Navy Clothing and Textile Research Facility, Army Research Institute of Environmental Medicine, and Natick Soldier Center.

- The Navy Clothing and Textile Research Facility is a unit of DOD. It is the primary developer of uniforms and protective clothing ensembles worn by Navy sailors. The R&D activities of the facility focus on the design, improvement, and assessment of protective garments and equipment, including ballistic helmets and vests, firefighting ensembles, life vests, environmental and steam protective clothing, chemical agent protection ensembles, and protective handwear and footwear. This federal facility annually receives about \$1.7 million of federal R&D funds, approximately \$1.5 million of which are spent on in-house activities, and has about 36 civilian personnel, only a portion of whom are directly involved in R&D activities.
- The Army Research Institute of Environmental Medicine is a unit of DOD. It conducts R&D in environmental and occupational medicine. More specifically, research is conducted in biochemistry, biophysics and biomedicine, thermal medicine, and environmental health research. This federal unit annually receives about \$10 million of federal R&D funding, approximately \$7 million of which is spent on in-house activities, and has about 79 civilian personnel.
- The Natick Soldier Center, formerly known as the Natick Research, Development, and Engineering Center, is a unit of DOD. It conducts R&D for the Army on the technologies required by

the soldier and soldier support systems, particularly soldier survivability, sustainability, mobility, and quality of life in the field. The R&D activities of the center touch on biotechnology, anthropometry, biomechanics, consumer research, textiles, fibers and materials, food science, aerodynamics, and modeling and simulation. This federal unit annually receives about \$89 million of federal R&D funds, approximately \$25 million of which is spent on in-house activities, and has about 450 civilian personnel, only a portion of whom are directly involved in R&D activities.

Northborough, Massachusetts, is home to DOI's Massachusetts District Office of Water Resources.

- The Massachusetts District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit, in combination with the Rhode Island District Office, annually receives approximately \$1.4 million in federal R&D funds.

Scituate, Massachusetts, is home to DOC's Stellwagen Bank National Marine Sactuary.

- The Stellwagen Bank National Marine Sanctuary is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). Such sanctuaries conduct research on the marine environment to identify areas of special national significance stemming from their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific R&D activities of this unit include studying how variations in the underwater landscape affect the distribution and abundance of fishes and related species and determining why endangered North Atlantic right whales spend time in Cape Cod Bay and the southern section of Stellwagen Bank during late winter and early spring. This federal unit annually receives approximately \$50,000 of federal R&D funds and has one FTE.

Turners Falls, Massachusetts, is home to DOI's Silvio O. Conte Anadromous Fish Research Laboratory.

- The Silvio O. Conte Anadromous Fish Research Laboratory is a unit of DOI's USGS. It conducts both basic and applied research relative to biological and management concerns regarding anadromous fish populations and their associated ecosystems. Specific research activities of this unit include restoring and enhancing anadromous fishes and discovering the environmental and resource consequences resulting from dams or altered ecosystems. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about 18 FTEs.

Winchester, Massachusetts, is home to HHS's Winchester Engineering and Analytical Center.

- The Winchester Engineering and Analytical Center is a unit of HHS's Food and Drug Administration. The center conducts research on medical devices, radiation-emitting products (e.g., microwaves), and radioactive drugs to determine their effect on health. This federal unit annually receives approximately \$3.4 million of federal R&D funds and has about 37 FTEs directly involved in R&D activities.

Woods Hole, Massachusetts, is home to DOC's Woods Hole Laboratory and DOI's Woods Hole Geology Field Center.

- The Woods Hole Laboratory is the headquarters of the Northeast Fisheries Science Center inside DOC's NOAA. The overall center monitors and analyzes fishery resources and their effects on the ecosystem. The specific research conducted at Woods Hole focuses on the collection and analysis of data on fishery resources and the status and dynamics of their habitat, the ecological processes that control resource productivity, and the performance of the fisheries. This federal unit annually receives approximately \$9.2 million of federal R&D funds and has about 115 FTEs, only a portion of whom are involved in R&D activities.
- Woods Hole Geology Field Center is a unit of DOI's USGS. It conducts research on the submerged regions of the U.S. Exclusive Economic Zone and the Great Lakes, focusing on the coastal areas. Specific research activities of this center include seafloor mapping of Massachusetts Bay; geologically interpreting the seafloor near Falkner Island, Connecticut; and conducting environmental research on contaminants and red tides. This federal R&D unit, which is affiliated with the Geologic Eastern Regional office in Reston, Virginia, annually receives approximately \$9.6 million of federal R&D funds and has about 70 employees.

FEDERAL R&D GRANTS TO MASSACHUSETTS ENTITIES

Every major institution of higher education in Massachusetts is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Harvard University, Massachusetts Institute of Technology (MIT), Boston University, the University of Massachusetts (U of Mass), Tufts University, Brandeis University,

Northeastern University, and Boston College (BC). The table below shows the total number of R&D grants that were active in FY 1998, highlighting those made by HHS, NSF, DOD, and NASA to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to Harvard are \$6 million from DOE and \$4 million from the EPA. The grants in this same category going to MIT include \$9 million from DOE and \$2 million each from DOC and EPA. The comparable grants going to Boston U include \$3 million from DOE and \$1 million from the Department of Education. The grants going to U of Mass include \$4 million from USDA, \$3 million from DOE, and \$1 million from the Department of Education.

Table 22.1 – Sources of Federal R&D Grants to Higher Education in Massachusetts

Institution	HHS		NSF		DOD		NASA		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Harvard	\$191M	715	\$19M	240	\$11M	44	\$5M	76	\$10M	54	\$236M	1,129
MIT	\$63M	246	\$30M	395	\$34M	154	\$11M	228	\$15M	87	\$152M	1,110
Boston Univ	\$87M	331	\$13M	180	\$8M	38	\$4M	67	\$5M	32	\$117M	648
U of Mass	\$60M	317	\$15M	238	\$5M	42	\$2M	34	\$8M	209	\$90M	840
Tufts	\$37M	176	\$2M	55	\$1M	4	<\$1M	8	\$2M	22	\$43M	265
Brandeis	\$18M	114	\$3M	49	<\$1M	3	<\$1M	8	\$1M	6	\$23M	180
Northeastern	\$5M	36	\$5M	87	\$4M	11	<\$1M	4	\$1M	12	\$15M	150
BC	\$4M	27	\$3M	34	<\$1M	4	<\$1M	7	<\$1M	9	\$8M	81
Other	\$10M	86	\$7M	145	\$1M	6	\$1M	20	\$1M	22	\$20M	279
Total	\$476M	2,048	\$97M	1,423	\$63M	306	\$23M	452	\$44M	453	\$703M	4,682

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each

year to various academic departments within these institutions, such as the School of Medicine at Harvard University.

Several other nonacademic institutions in Massachusetts also receive a significant amount of federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are Massachusetts General Hospital in Boston (\$136 million), Brigham & Women's Hospital in Brookline (\$133 million), Dana-Farber Cancer Institute in Boston (\$64 million), Beth Israel Hospital in Boston (\$63 million), and Children's Hospital in Boston (\$50 million). Worthy of note as well, the Woods Hole Oceanographic Institute received over \$21 million of R&D grants from NSF alone in FY 1998.

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Massachusetts received 627 SBIR awards totaling \$160 million. Examples include an \$800,000 award from HHS to Innovative Training Systems, Inc., in Newton for development of an addiction-severity assessment tool and a \$700,000 award from DOE to Physical Sciences, Inc., in Andover for work on control of mercury emissions from fossil fuel-fired power plants.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Massachusetts are ones valued at more than \$2.2 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Massachusetts every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MASSACHUSETTS

Several entities located in Massachusetts also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to the Raytheon Company, which in FY 1998 received close to \$180 million in contracts from DOD for R&D work on such programs as the National Missile Defense Ground-Based Radar, Joint Precision Strike Demonstration, and RIM-7P Sea Sparrow Missile Systems. In addition, Range Systems Engineering Company (\$113 million), Tasc, Inc. (\$63 million), the Institute for Defense and Disarmament Studies (\$50 million), and Abt Associates (\$39 million) received very large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. For example, Abt Associates received close to \$25 million in R&D grants from HHS in FY 1998. Also worthy of particular note are the more than \$20 million in contracts awarded each year by NASA to the Smithsonian Institution, another federal R&D agency, for R&D at the Chandra X-Ray Observatory, formerly the Advanced X-Ray Astrophysics Facility, in Cambridge, Massachusetts. MIT, Boston University, and the University of Massachusetts also received contracts from various federal agencies to conduct R&D for the federal government that totaled several million dollars for each university. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$97 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities located in Massachusetts. By far the largest of these cooperative agreements (\$28 million) came from DOE to support the Laboratory for Nuclear Science at MIT. Another of these cooperative agreements (\$100,000) came from DOC to the Woods Hole Oceanographic Institution to operate the Cooperative Institute of Climate and Ocean Research (CICOR). Other federal agencies awarding cooperative agreements to Massachusetts-based entities include NSF, DOD, and DOC. Among these latter cooperative agreements are awards supporting three of NSF's Materials Research Science and Engineering Centers—the Cen-

ter for Polymer Science and Engineering at the University of Massachusetts at Amherst, the Center for Materials Science and Engineering at MIT, and the Materials Research Center at Harvard.

Chapter 23

Federal Research and Development in Michigan

- Approximately \$827 million of federal R&D funds are spent each year in Michigan.
- Michigan ranks 21st among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 6 percent of all federal funds spent in Michigan each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

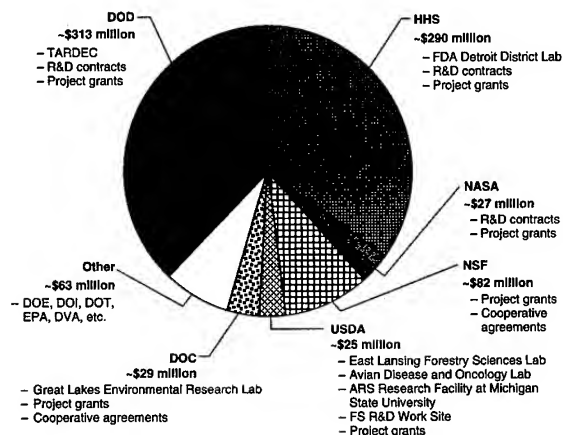


Figure 23.1 – Sources of Federal R&D Dollars Spent in Michigan
(Total Federal R&D ~\$827 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$827 million annually in Michigan on research and development (R&D) activities. On average, federal dollars for R&D account for approximately 6 percent of all federal funds received by Michigan for purposes other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts fund significant R&D activities in Michigan. Foremost among these agencies are the Departments of Defense (DOD) and Health and Human Services (HHS), which account for 38 and 35 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF) accounts for 10 percent of all federal R&D dollars spent in Michigan, while the Departments of Agriculture (USDA) and Commerce (DOC) and the National Aeronautics and Space Administration (NASA) each account for an additional 3 percent. The remaining federal R&D dollars come collectively from the Department of Energy (DOE), the Environmental Protection Agency (EPA), and several other federal agencies.²³

All federal R&D dollars spent in Michigan either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, and cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Michigan.

FEDERAL R&D UNITS IN MICHIGAN

Ann Arbor, Michigan, is home to DOC's Great Lakes Environmental Research Laboratory, DOI's Great Lakes Science Center, and a Department of Veterans Affairs (DVA) R&D unit.

- The Great Lakes Environmental Research Laboratory (GLERL) is a unit of DOC's National Oceanic and Atmospheric Admin-

²³ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

istration (NOAA). It conducts environmental research in support of resource management and environmental services in coastal and estuarine water, with special emphasis on the Great Lakes. Among the research areas of interest to the laboratory are climate change and variability, ecosystem dynamics, water resources research, and aquatic contaminants. This federal unit annually receives approximately \$6 million of federal R&D funds and has about 58 FTEs.

- The Great Lakes Science Center is a unit of DOI's U.S. Geological Survey (USGS). It is on the north campus of the University of Michigan, with three field stations located in Cheboygan, Munising, and Millersburg. The center conducts research on fish populations and communities, aquatic habitats, terrestrial ecology, nearshore and coastal communities, and the biological processes that occur in the complex ecosystem of the Great Lakes. Specific research activities of the Cheboygan field station focus on hydroacoustics, food web dynamics, and fish community and population dynamics. Specific research activities of the Munising Biological Station focus on disturbance regimes of Great Lakes coastal vegetation with an emphasis on fire and dune dynamics. Specific research activities of the Hammond Bay Biological Station focus on the effects of sea lampreys on Great Lakes fish. These federal R&D units combined annually receive approximately \$2.9 million of federal R&D funds and have about 53 FTEs.
- While the principal focus of the DVA Medical Center in Ann Arbor is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 369 projects with total funding of approximately \$4.5 million. These R&D activities focus on a wide range of topics, including aging, drug therapy, liver diseases, diabetes mellitus, hypertension, and kidney diseases.

Detroit, Michigan, is home to HHS's Detroit District Laboratory and a DVA R&D unit.

- The Detroit District Laboratory is a unit of HHS's Food and Drug Administration. It conducts research on the safety and efficacy of human drugs. This federal unit annually receives approximately \$163,000 of federal R&D dollars and has about four FTEs directly involved in R&D activities. This unit is scheduled to close in 2000.
- While the principal focus of the John D. Dingell VA Medical Center in Detroit is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 151 projects with total funding of approximately \$1.6 million. These R&D activities focus on a wide range of topics, including hypertension, schizophrenia, diabetes mellitus, neoplasms, congestive heart failure, and antihypertensive agents.

East Lansing, Michigan, is home to USDA's East Lansing Forestry Sciences Laboratory, Agricultural Research Service (ARS) Research Facility at Michigan State University, and Avian Disease and Oncology Laboratory.

- The East Lansing Forestry Sciences Laboratory is a unit of the North Central Forest Experiment Station inside USDA's Forest Service. It conducts research on atmospheric and socioeconomic relations with wildland fire, forest tree pest interaction, and forest management techniques. Specific research activities of this lab include investigating the relationship between atmospheric interactions and ecosystem processes, evaluating the effects of various environmental stresses on tree/insect/natural enemy interactions, and comparing the costs and benefits of managing public and private forests. This federal R&D unit annually receives approximately \$1.6 million of federal R&D funds and has about 12 employees.
- The ARS Research Facility at Michigan State University is a unit of USDA's ARS. It consists of two research divisions—the Sugarbeet and Bean Research Laboratory and the Fruit and Vegetable Harvesting Research Laboratory. The facility con-

ducts research on the breeding of sugarbeets and beans and the development of techniques and practices for improving the production and handling of vegetables. Specific research activities of this facility include the development of new and improved methods for screening and evaluating disease and pest resistance, the development of germplasm that possess the traits deemed most desirable, and the identification of alternatives to chlorine and chlorine dioxide in vegetable wash water and pasteurizer wastewater. This federal R&D unit, together with the Avian Disease and Oncology Laboratory described immediately below, annually receives approximately \$4.1 million of federal R&D funds and has about 47 FTEs.

- The Avian Disease and Oncology Laboratory is a unit of USDA's ARS located on the campus of Michigan State University. It conducts research on avian leukosis, a group of diseases resembling cancer that are important causes of mortality in chickens. Specific research activities at the laboratory include studies to minimize viral disease in chickens and turkeys and studies to make poultry food products cheaper and of higher quality for consumers. The funding and staffing information for this federal R&D unit are included in those presented above for the ARS Research Facility.

Grosse Ile, Michigan, is home to EPA's Large Lakes Research Station.

- The Large Lakes Research Station is a research site of the Mid-Continent Ecology Division of EPA's National Health and Environmental Effects Research Laboratory in Duluth, Minnesota. This site conducts research on the sources and effects of air and water pollutants entering the Great Lakes and develops mathematical models for evaluating the impacts of toxic pollutants on large-lake ecosystems. It also develops the technology to assess and predict the present and future effects of biotic and abiotic stressors on freshwater ecological resources in support of short- and long-term management goals. The funding and staffing information for this site are included in those provided for the Mid-Continent Ecology Division in Duluth, Minnesota.

Houghton, Michigan, is home to a USDA Forest Service R&D Work Site.

- The R&D Work Site is a unit of the North Central Forest Experiment Station inside USDA's Forest Service. It conducts research on the technologies needed to manage forest ecosystems. Specific research activities of this unit include developing new ways to plan, conduct, and evaluate forest operations that minimize the negative long-term impacts on forest ecosystems. This federal R&D unit annually receives approximately \$726,000 of federal R&D funds and has about nine employees.

Lansing, Michigan, is home to DOI's Michigan District Office of Water Resources.

- The Michigan District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$860,000 in federal R&D funds.

Warren, Michigan, is home to DOD's Tank-Automotive Research, Development, and Engineering Center.

- The Tank-Automotive Research, Development, and Engineering Center is a unit of DOD. It is the research center within the U.S. Army Tank-Automotive and Armaments Command responsible for tank and automotive activities. Specifically, the center's primary focus is on developing main battle tanks, tracked fighting vehicles, and other military automotive products. It conducts R&D on bridging, logistics equipment, fuels, lubricants, and mechanical countermeasure apparatuses. The central research objective of the center is to make Army mounted forces lighter, more lethal, and more deployable, while improving their tactical mobility and survivability. This federal facility annually receives approximately \$140 million of federal R&D funds, approximately \$30 million of which is spent on in-house activities, and has about 1,100 civilian personnel.

FEDERAL R&D GRANTS TO MICHIGAN ENTITIES

Every major institution of higher education in Michigan is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Michigan, Wayne State University, Michigan State University, Michigan Technological University, Oakland University, and Western Michigan University (WMU). The table below shows the total number of R&D awards that were active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to U of Michigan are \$8 million from DOE, \$5 million from EPA, \$4 million from NASA, and \$1 million each from DOC and the Department of Education. The comparable grants going to Michigan State include \$10 million from USDA, \$5 million from DOE, \$2 million from NASA, and \$1 million from EPA. Michigan Tech receives most of the grants in this category from the EPA.

Table 23.1 – Sources of Federal R&D Grants to Higher Education in Michigan

Institution	HHS		NSF		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Michigan	\$207M	890	\$29M	477	\$15M	88	\$21M	231	\$272M	1,686
Wayne State	\$52M	255	\$4M	74	\$3M	17	\$2M	22	\$60M	368
Michigan State	\$21M	119	\$14M	207	\$3M	13	\$19M	526	\$57M	865
Michigan Tech	<\$1M	2	\$4M	58	\$1M	9	\$5M	50	\$10M	119
Oakland	\$2M	13	\$1M	13	0	0	0	0	\$3M	26
WMU	\$1M	13	\$1M	18	<\$1M	1	\$1M	7	\$2M	39
Other	\$1M	11	\$1M	40	<\$1M	1	\$1M	22	\$3M	74
Total	\$284M	1,303	\$54M	887	\$21M	129	\$48M	858	\$408M	3,177

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Physics Department at the University of Michigan.

Several other nonacademic institutions in Michigan also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received grants in FY 1998 were the Henry Ford Health System in Detroit (\$20 million) and NSF International (\$5 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Michigan received 114 SBIR awards totaling \$32 million. Examples include a \$600,000 award from NASA to Michigan Technic Corp. in Holland to study safety hazards and emergency deployment of a tethered satellite system and a \$700,000 award from HHS to Ia, Inc., in Ann Arbor for work on a fiberoptic sensor for environmental pseudoestrogens.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Michigan are ones valued at more than \$5.2 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from the U.S. Geological Survey (USGS) in DOI to the Water Resources Research Institute in Michigan every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MICHIGAN

Several entities located in Michigan also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds in FY 1998 went from DOD to General Dynamics Land Systems (\$89 million) for work that included the Advanced Amphibious Assault Vehicle (AAAV) program and the Abrams M1A2 Tank. In addition, Erim International (\$10 million), Optimetrics, Inc. (\$4 million), the Michigan Department of Community Health (\$4 million), and FEV Engine Technology, Inc. (\$4 million), received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Erim International. Wayne State University (\$14 million), the University of Michigan (\$10 million), and Michigan State University (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$63 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities located in Michigan. The largest of these cooperative agreements (\$16 million) came from DOE to the U.S. Advanced Battery Consortium in Dearborn

for R&D on advanced batteries for electric vehicles. Another cooperative agreement for \$2.7 million came from DOC to the University of Michigan to support the Cooperative Institute for Limnology and Ecosystems Research (CILER), which was established specifically to promote collaborative research between NOAA's GLERL (see description above) and scientists from throughout the Great Lakes basin. Other federal agencies awarding cooperative agreements to Michigan-based entities include NSF and DOD. Among these latter cooperative agreements are awards supporting two of NSF's Science and Technology Centers—the Center for Ultrafast Optical Science at the University of Michigan and the Center for Microbial Ecology at Michigan State University. In addition, Michigan is home to one of NSF's Materials Research Science and Engineering Centers—the Center for Sensor Materials at Michigan State University.

Chapter 24

Federal Research and Development in Minnesota

- Approximately \$653 million of federal R&D funds are spent each year in Minnesota.
- Minnesota ranks 24th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 8 percent of all federal funds spent in Minnesota each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

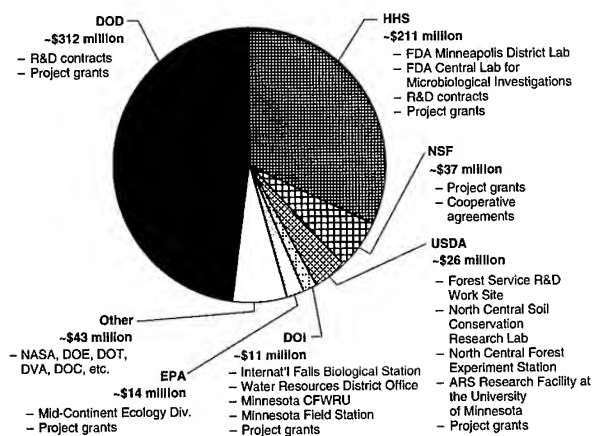


Figure 24.1 – Sources of Federal R&D Dollars Spent in Minnesota
(Total Federal R&D ~\$653 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$653 million annually in Minnesota on research and development (R&D) activities. On average, federal R&D dollars account for approximately 8 percent of all federal funds spent in Minnesota each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Minnesota. Foremost among these agencies are the Departments of Defense (DOD) and Health and Human Services (HHS), which account for 48 and 32 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF), the Department of Agriculture (USDA), the Environmental Protection Agency (EPA), the Department of Interior (DOI), and the Department of Commerce (DOC), account for an additional 6, 4, 2, 2, and 2 percent of the federal R&D dollars spent in Minnesota, respectively. The remaining federal R&D dollars come collectively from the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), the Department of Transportation (DOT), and several other federal agencies.²⁴

All federal R&D dollars spent in Minnesota either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Minnesota.

FEDERAL R&D UNITS IN MINNESOTA

Duluth, Minnesota, is home to EPA's Mid-Continent Ecology Division.

- The Mid-Continent Ecology Division is a unit of EPA's National Health and Environmental Effects Research Laboratory headquartered in Research Triangle Park, North Carolina. It

²⁴ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

provides scientific information on ecotoxicology and freshwater ecological effects to reduce the uncertainty in risk assessments and support risk management option selections. Located on the north shore of Lake Superior in Duluth, Minnesota, with a second site in Grosse Ile, Michigan, the division conducts research to address critical scientific issues facing the Great Lakes and Great Plains. This federal R&D unit annually receives approximately \$13.2 million of federal R&D funds and has about 105 FTEs.

Grand Rapids, Minnesota, is home to a USDA Forest Service R&D Work Site.

- The R&D Work Site is a unit of the North Central Forest Experiment Station inside USDA's Forest Service. It conducts research on the ecology and culture of the northern lake states and on riparian and aquatic ecosystems. Specific research activities of this unit include developing silvicultural management methods and developing aquatic and riparian classification systems. This federal R&D unit annually receives approximately \$2.3 million of federal R&D funds and has about 20 employees.

International Falls, Minnesota, is home to DOI's International Falls Biological Station.

- The International Falls Biological Station is a unit of the Columbia Environmental Research Center inside DOI's U.S. Geological Survey (USGS). It conducts research on fish communities in boreal lakes and reservoirs in Minnesota and Michigan, including Voyageurs National Park and Isle Royale National Park. Specific research activities of this unit include assessing the ecological impacts of exotic rainbow smelt and assessing the reproductive isolation between two northern pike spawning populations in Kabetogama Lake, Voyageurs National Park. This federal R&D unit annually receives approximately \$71,000 in federal R&D funds and has one FTE.

Minneapolis, Minnesota, is home to HHS's Minneapolis District Laboratory and Central Laboratory for Microbiological Investigations and a Department of Veterans Affairs (DVA) R&D unit.

- The Minneapolis District Laboratory and the Central Laboratory for Microbiological Investigations are units of HHS's Food and Drug Administration. These units conduct research on the safety and effectiveness of food and medical devices. Specific areas of research activity focus on pesticides and industrial chemicals. These federal units annually receive approximately \$407,000 of federal R&D funds and have about five FTEs. This unit is scheduled to close in 2000.
- While the principal focus of the Minneapolis VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 533 projects with total funding of approximately \$7 million. These R&D activities focus on a wide range of topics, including neoplasms, emission-computed tomography, congestive heart failure, Alzheimer's disease, and diabetes.

Morris, Minnesota, is home to USDA's North Central Soil Conservation Research Laboratory.

- The North Central Soil Conservation Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of the University of Minnesota at Morris. It conducts research to develop and transfer new knowledge and technologies for sustainable agriculture in northern climatic regions that protect natural resources and the environment. Specific research activities of this laboratory include variable soil types within a farming/field unit that preclude uniform management, poorly distributed and intensive precipitation that causes water runoff and soil erosion as well as plant growth stress, and weed/pests management pressures that cause economic and environmental concerns. This federal R&D unit annually receives approximately \$2.3 million of federal R&D funds and has about 34 FTEs.

Mounds View, Minnesota, is home to DOI's Minnesota District Office of Water Resources.

- The Minnesota District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.8 million in federal R&D funds.

St. Paul, Minnesota, is home to DOI's Minnesota Cooperative Fish and Wildlife Research Unit Field Station and USDA's ARS Research Facility at the University of Minnesota and North Central Forest Experiment Station.

- The Minnesota Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of the University of Minnesota. It conducts research on the impact of human activities on aquatic and terrestrial ecosystems of state, regional, and national significance. Specific research activities of this unit include studying the ecology and management of boreal owls in northeast Minnesota, studying the breeding ecology and habitat use of red-shouldered hawks in Minnesota, and investigating the habitat associations and winter ecology of fer-

ruginous hawks in eastern Colorado. This federal R&D unit annually receives approximately \$175,000 of federal R&D funds and has about three FTEs.

- The Minnesota Field Station is a unit of the Northern Prairie Wildlife Research Center inside DOI's USGS. It is on the campus of the University of Minnesota. It conducts research on wolf ecology. Specific research activities of this unit include studying ways to restore the wolf population and studying wolf behavior to determine the reaction of other populations during ecosystem restoration. This federal R&D unit annually receives approximately \$400,000 of federal R&D funds and has about four FTEs.
- The ARS Research Facility at the University of Minnesota is a unit of USDA's ARS. It consists of three research divisions focusing on plant science, soil and water management, and cereal rust. It conducts research on the fundamental processes controlling increased production, improved quality, and enhanced use of alfalfa, oat, wheat, and soybean and fundamental soil properties and processes affected by conservation tillage and residue management. Specific research activities of this facility include nitrogen fixation and assimilation, forage quality and persistence, plant disease resistance, and response to environmental stress. This federal R&D unit annually receives approximately \$5.5 million of federal R&D funds and has about 53 FTEs.
- The North Central Forest Experiment Station, headquartered in St. Paul, is a unit inside USDA's Forest Service. It conducts research on the impact of global change on North Central forests, tree diseases, and ecosystem management and keeps a forest inventory. Specific research activities of this unit include investigating multiple approaches to improve disease resistance in trees, conducting inventories of the forests in the North Central states and researching the linkages and interactions between social systems and ecosystems. This federal R&D unit annually

receives approximately \$4.9 million of federal R&D funds and has about 125 employees.

FEDERAL R&D GRANTS TO MINNESOTA ENTITIES

Every major institution of higher education in Minnesota is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, DOE, and DOD to individual faculty members and therefore ultimately inure to the benefit of institutions such as the University of Minnesota system. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, DOE, and DOD to parties at this institution and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Minnesota are ones from NASA (\$3 million), USDA (\$3 million), the Department of Education (\$2 million), and EPA (\$1.5 million).

Table 24.1 – Sources of Federal R&D Grants to Higher Education in Minnesota

	HHS		NSF		DOE		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Minn	\$134M	626	\$26M	391	\$7M	35	\$4M	53	\$10M	416	\$181M	1,521
Other	<\$1M	10	\$2M	40	0	0	0	0	<\$1M	13	\$2M	63
Total	\$135M	636	\$28M	431	\$7M	35	\$4M	53	\$10M	429	\$183M	1,584

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the University of Minnesota Medical School.

Several other nonacademic institutions in Minnesota also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 were the Mayo Foundation in Rochester (\$71 million), the Minnesota Agricultural Experiment Station in St. Paul (\$5 million), the Minneapolis Medical Research Foundation (\$4 million), and the Minnesota State Department of Health in Minneapolis (\$3 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Minnesota received 64 SBIR awards totaling close to \$11 million. Examples include a \$750,000 award from DOD (Ballistic Missile Defense Organization) to Ross-Hime Designs, Inc., in Minneapolis for researching and developing an omnidirectional sensor mount and a \$400,000 award from NSF to Xetex, Inc., in Minneapolis for work on a multifunction heat exchanger for control of temperature, moisture, and air quality.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Minnesota are ones valued at more than \$5 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Minnesota every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MINNESOTA

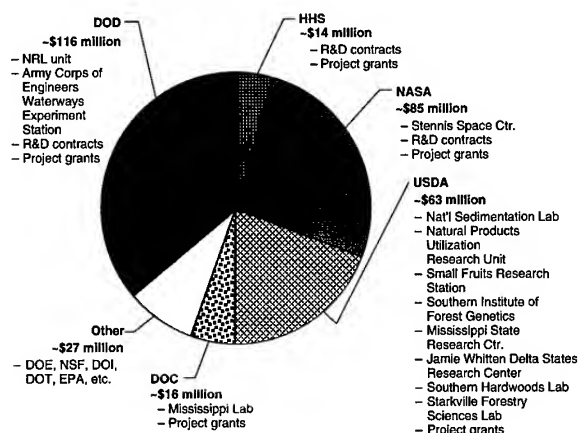
Several entities in Minnesota also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from DOD to United Defense, L.P., which in FY 1998 received close to \$381 million primarily in support of the Army's Advanced Field Artillery System/Future Armored Resupply Vehicle (AFAS/FARV) program. In addition, Alliant TechSystems, Inc. (\$49 million), Honeywell (\$27 million), General Dynamics Corp. (\$23 million), Lockheed Martin Corp. (\$7 million), and the Mayo Foundation (\$6 million) received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by the Mayo Foundation. The University of Minnesota (\$35 million) also receives contracts from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$13 million of federal R&D dollars was also received in FY 1998 by entities located in Minnesota in the form of cooperative agreements. The largest of these cooperative agreements (\$3 million in FY 1998) came from DOD (Air Force) to Honeywell, Inc., in Minneapolis to develop photonic and optoelectronic components for an advanced multifunctional C3I surveillance system. Other federal agencies awarding cooperative agreements to Minnesota-based entities include DOE, DOC, and NSF. Among these latter cooperative agreements is an award supporting one of NSF's Science and Technology Centers—the Center for Computation and Visualization of Geometric Structures at the University of Minnesota. In addition, Minnesota is home to one of NSF's Materials Research Science and Engineering Centers at the University of Minnesota.

Chapter 25

Federal Research and Development in Mississippi

- Approximately \$322 million of federal R&D funds are spent each year in Mississippi.
- Mississippi ranks 30th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 5 percent of all federal funds spent in Mississippi each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.



**Figure 25.1 – Sources of Federal R&D Dollars Spent in Mississippi
(Total Federal R&D ~\$322 million)**

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$322 million annually in Mississippi on research and development (R&D) activities. On average, federal R&D dollars account for approximately 5 percent of all federal funds spent in Mississippi each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Mississippi. Foremost among these agencies are the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and the Department of Agriculture (USDA), which account for 36, 26, and 20 percent of all federal R&D dollars spent in the state, respectively. The Departments of Commerce (DOC) and Health and Human Services (HHS) account for an additional 5 and 4 percent of all federal R&D dollars spent in Mississippi, respectively. The remaining federal R&D dollars come collectively from the National Science Foundation (NSF), the Department of Energy (DOE), and several other federal agencies.²⁵

All federal R&D dollars spent in Mississippi either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Mississippi.

FEDERAL R&D UNITS IN MISSISSIPPI

Bay St. Louis, Mississippi, is home to NASA's Stennis Space Center, DOD's Naval Research Laboratory Research Site, and DOC's Mississippi Laboratory.

- The John C. Stennis Space Center is a unit of NASA. It is directly involved in the static test firing of large rocket engines and

²⁵ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

propulsion systems. The center also provides support for the Shuttle Test Program through operation and maintenance of facilities used for developmental testing of the Space Shuttle Main Engine and the Orbiter Main Propulsion Test Program. Additionally, it conducts research on terrestrial applications through the Earth Resources Laboratory, which develops research applications techniques, remote sensing systems, and Geographic Information Systems (GIS) for public and private applications. This federal facility annually receives a total of about \$158 million, at least \$61 million of which directly involves R&D efforts. The center has about 244 FTEs, only a portion of whom are involved in R&D activities. A substantial portion of its funds is spent on the maintenance and operation of R&D equipment and facilities. In a recent year, the center awarded over \$11 million of R&D contracts, about \$6 million of which were made to entities based in Mississippi.

- The Naval Research Laboratory Research Site is a unit of DOD. It is in the same complex as the Stennis Space Center and conducts R&D on a variety of oceanographic and atmospheric matters. The funding and staffing for this site are modest and are included in the figures presented for the main laboratory in the District of Columbia.
- The Mississippi Laboratory is a unit of the Southeast Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts resource surveys of fish, endangered species, and marine mammals and performs research on fisheries gear. The laboratory also manages the Latent Resource Program and the Southeastern Area Monitoring and Assessment Program to collect, manage, and distribute fishery independent data. The laboratory is responsible for providing research vessels for NOAA research activities. It maintains two research vessels in Pascagoula for taking samples to estimate distribution, abundance, and trends of fishery resources. This federal unit annually receives approximately \$3.5 million of federal R&D funds and has about 38 FTEs.

Jackson, Mississippi, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Jackson VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 83 projects with total funding of approximately \$700,000. These R&D activities focus on a wide range of topics, including neoplasms, sickle-cell anemia, anxiety disorders, and substance abuse.

Oxford, Mississippi, is home to USDA's National Sedimentation Laboratory and Natural Products Utilization Research Unit.

- The National Sedimentation Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the Oxford campus of Mississippi State University. It consists of three research divisions focusing on upland erosion processes, channel and watershed processes, and water quality and ecological processes. It conducts research on soil erosion and sediment delivery from upland areas, erosion and sedimentation in stream channels, the impact of sediment and other agricultural contaminants on the biological well-being of streams, and the loss of nutrients and agricultural chemicals from agricultural activities on the landscape. Specific research activities of this laboratory include transport and deposition of sediment; movement of chemicals on upland areas and in streams; the impact of agricultural practices, in-stream structures, and bank protection on these processes; water quality; and the ecological well-being of streams. This federal R&D unit annually receives approximately \$7.8 million of federal R&D funds and has about 68 employees.
- The Natural Products Utilization Research Unit is part of USDA's ARS located on the campus of Mississippi State University. It conducts research on natural products for use in agricultural pest management, with emphasis on pest management agents derived from plants. Specific research activities of

this unit are focused on products for agricultural sectors that the agrochemical industry has little interest in, such as horticultural crops and aquaculture, and the development of medicinal plants as alternative crops. The funding and staffing for this federal R&D unit is included in those presented above for the National Sedimentation Laboratory.

Pascagoula, Mississippi, is home to DOC's Mississippi Laboratory Pascagoula Facility.

- The Pascagoula Facility is a facility of the Mississippi Laboratory inside DOC's NOAA. The laboratory is headquartered in Bay St. Louis. The facility is the home of two NOAA vessels used for research—the *Oregon II* and the *Gunter*. The research at the facility focuses on resource surveys of fish, endangered species, and marine mammals. Currently, the Pascagoula Facility supports the following surveys internally: bottom trawling, plankton, trap/video, mammals, trawl/acoustics, and aerial surveys. It also participates in the following external surveys: South Atlantic SEAMAP (trawling), MARMAP (shallow reef fish), and Caribbean SEAMAP (shallow reef fish). The facility also conducts gear technology studies aimed at developing fishing devices to reduce bycatch of unwanted or protected species. Current gear studies center around utilizing gear experts, communication with the fishing industry, conducting dive trips, and taking videos to assimilate information surrounding types of gear and impact on the resources. The funding and staffing information for this facility are included in those presented for the Mississippi Laboratory.

Pearl, Mississippi, is home to the Department of Interior's (DOI) Mississippi District Office of Water Resources.

- The Mississippi District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs.

The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.9 million in federal R&D funds.

Poplarville, Mississippi, is home to USDA's U.S. Small Fruits Research Station.

- The U.S. Small Fruits Research Station is a unit of USDA's ARS located on the Poplarville campus of Mississippi State University. It conducts research on new and improved cultural and management practices for small fruit. Specific research activities of this laboratory include the development of new and improved small fruit cultivars adapted to the Gulf Coast states. This federal R&D unit annually receives approximately \$1.1 million of federal R&D funds and has about 15 FTEs.

Saucier, Mississippi, is home to USDA's Southern Institute of Forest Genetics.

- The Southern Institute of Forest Genetics is a unit of the Southern Research Station inside USDA's Forest Service. The institute is headquartered in Saucier, with facilities in Huntsville, Alabama; College Station, Texas; and Gainesville, Florida. Many of its activities focus on the Harrison Experimental Forest, 25 miles north of Gulfport, Mississippi. The institute conducts research on the principles of heredity that operate in southern

forests and demonstrates how these principles may be applied to sustain and enhance forest quality and productivity. Specific research activities of this unit include developing population management strategies for southern pine ecosystems that will maintain or enhance genetic diversity in the long term and provide the basis for genetic improvement in the short term. Other activities include elucidating the genetic principles and evolutionary forces that influence genetic variation within and among forest species, understanding the molecular genetic organization and function of forest species, and developing strategies for the management of forests at risk to disease. This federal R&D unit annually receives approximately \$1.8 million of federal R&D funds and has about 11 employees.

Starkville, Mississippi, is home to USDA's Mississippi State Research Center and Starkville Forestry Sciences Laboratory and DOI's Mississippi Cooperative Fish and Wildlife Research Unit.

- The Mississippi State Research Center is a unit of USDA's ARS located on the campus of Mississippi State University. It consists of three research divisions focusing on biological control and mass rearing, poultry, and crop science. The center conducts research on the production and use of natural enemies for control of agricultural pests and the improvement of poultry production efficiency and product quality. Specific research activities of the center include the development of in vivo and in vitro mass rearing methods and technology, including technology for harvesting, packaging, storage, and distribution of quality-assured natural enemies. This federal R&D unit annually receives approximately \$7.5 million of federal R&D funds and has about 88 FTEs.
- The Starkville Forestry Sciences Laboratory is a unit of the Southern Research Station inside USDA's Forest Service. It conducts research on seed tree genetics, rural fires, and the role of termites in forest ecosystems. It is adjacent to Mississippi State University. Specific research activities of this unit include improving the protection of wood against damage; incorporating

remote sensing technology into the forest inventory process; screening and testing new and alternative compounds, materials, and treatment techniques for effective protection against damage caused by subterranean termites; and understanding the many risk factors that have allowed Formosan termites to survive standard termiticide treatments. This federal R&D unit annually receives approximately \$4 million of federal R&D funds and has about 77 employees.

- The Mississippi Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Mississippi State University. It conducts research on forest and wildlife ecology. Specific research activities of this unit include studying how the neotropical landbird uses national forest lands; using gap analysis to study conservation and biodiversity in Mississippi; investigating the movement, spawning, and recruitment of Gulf coast strain walleye; and assessing tree frogs in Puerto Rico. This federal R&D unit annually receives approximately \$245,000 of federal R&D funds and has about three FTEs.

Stoneville, Mississippi, is home to USDA's Jamie Whitten Delta States Research Center and Southern Hardwoods Laboratory.

- The Jamie Whitten Delta States Research Center is a unit of USDA's ARS located on the Stoneville campus of Mississippi State University. It consists of nine research divisions that focus on soybean production, southern insect management, cotton physiology and genetics, southern weeds, cotton ginning, catfish genetics, and application and production technology. Specific research activities include developing new equipment and technology to allow more precise application and placement of pesticides to specific sites without excessive drift; developing breeding strategies to genetically improve catfish for commercial production in the Mid-South; developing methods for augmenting parasite populations to manage insect pests of field crops; and developing sustainable integrated weed management systems for agronomic, horticultural, and aquatic crops. This federal R&D unit annually receives approximately \$16.8 million of federal R&D funds and has about 172 FTEs.

- The Southern Hardwoods Laboratory is a unit of the Southern Research Station inside USDA's Forest Service. While it has long-term research sites Louisiana and elsewhere in Mississippi, its main facility, known as the Center for Bottomland Hardwoods, is at Stoneville. It conducts research on plant pathology, entomology, plant physiology, and dendrochronology. Specific research activities of this unit include research on the sustainable management of southern bottomland hardwood, wetland forests, and associated stream ecosystems; regeneration and reproductive biology; stand management, growth, and yield; ecology of aquatic and terrestrial fauna; and ecological processes and ecosystem restoration. Other activities focus on developing methods of collecting, conditioning, and storing eastern forest tree seeds that will generate and maintain high seed quality. This federal R&D unit annually receives approximately \$3.2 million of federal R&D funds and has about 34 employees, 23 of whom are located in Stoneville.

Vicksburg, Mississippi, is home to DOD's Waterways Experiment Station and DOI's Vicksburg Field Station.

- The Waterways Experiment Station is a unit of the Army Corps of Engineers inside DOD. It consists of the Coastal and Hydraulics Laboratory, the Environmental Laboratory, the Geotechnical Laboratory, the Information Technology Laboratory, and the Structures Laboratory and focuses on the civil engineering aspects of airfields and pavements, survivability and protective structures, and sustainment engineering. It conducts R&D on weapons effects; fighting positions; terrorist threat protection; structural hardening; fixed facility camouflage, concealment, and deception; bridge assessment and repair; vehicle/terrain interaction; military hydrology; lines of communications, construction, and repair; airfields and pavements; coastal engineering; coastal oceanography; littoral processes; hydraulic engineering; flood control and navigation; dynamic modeling and simulation; environmental impact; environmental restoration, aquatic plant control, zebra mussels, recreation, dredging,

and contaminated sediments; groundwater modeling; engineering geology; wetlands processes; environmental and geotechnical site characterization; ecosystem processes; reservoir, riverine, estuarine, and coastal water quality; mobility analyses; seismic response of structures; earthquake engineering; dredging and dredged material disposal; natural resources management; concrete technology; structural dynamics; and geotechnical engineering. This federal unit annually receives approximately \$237 million of federal R&D dollars, about \$146 million of which are spent on in-house activities, and has about 1,223 civilian personnel, only a portion of whom are involved in R&D activities. In 1999, the Waterways Experiment Station became part of the Engineer Research and Development Center, which also oversees laboratories in Hanover, New Hampshire; Champaign-Urbana, Illinois; and Alexandria, Virginia.

- The Vicksburg Field Station is a unit of the Patuxent Wildlife Research Center inside DOI's USGS. It conducts research on migratory birds, waterfowl harvests, wildlife habitats, environmental contaminants, endangered species, and wildlife populations. Specific research activities of this unit include studying the status and trends of biological resources, the effects of ecological processes and human impacts on biological resources, the restoration and maintenance of sustainable ecological systems, and the management and transfer of natural resources information and technology. This federal R&D unit annually receives approximately \$294,000 of federal R&D funds and has about three FTEs.

FEDERAL R&D GRANTS TO MISSISSIPPI ENTITIES

Every major institution of higher education in Mississippi is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, USDA, and DOD to individual faculty members and therefore ulti-

mately inure to the benefit of such institutions as Mississippi State University (MSU), the University of Mississippi (U of Miss), Jackson State University (JSU), the University of Southern Mississippi (USM), and Alcorn State University. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, USDA, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to MSU are ones from DOE (\$4 million), NSF (\$2 million), NASA (\$1 million), and the Department of Education (\$1 million). The comparable grants going to the University of Mississippi include \$1 million each from EPA and NSF.

Table 25.1 – Sources of Federal R&D Grants to Higher Education in Mississippi

Institution	HHS		USDA		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
MSU	<\$1M	8	\$7M	196	\$4M	17	\$9M	55	\$20M	276
U of Miss	\$9M	66	<\$1M	1	\$2M	14	\$3M	35	\$14M	116
JSU	\$5M	9	0	0	<\$1M	4	\$1M	13	\$6M	26
USM	<\$1M	4	<\$1M	4	\$3M	9	\$1M	22	\$4M	39
Alcorn	\$1M	3	\$1M	15	0	0	<\$1M	3	\$2M	21
Other	\$1M	7	\$1M	3	0	0	<\$1M	9	\$2M	19
Total	\$16M	97	\$9M	219	\$9M	44	\$14M	137	\$48M	497

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the University of Mississippi Medical Center.

Several other nonacademic institutions in Mississippi also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Institute for Technology De-

velopment in Jackson (\$3 million), the Mississippi/Alabama Sea Grant Consortium in Ocean Springs (\$2 million), the Mississippi State Department of Health in Jackson (\$1 million), and the Gulf Coast Research Laboratory in Ocean Springs (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Mississippi received two SBIR awards totaling close to \$125,000. These included a \$70,000 award from NASA to Global Aircraft Corp. in Starkville for work on an innovative low-cost composite "spray-up toolings system" (STS) and a \$55,000 award from USDA to TASKPRO, Inc., in Starkville to study the use of mechanical forces to control nonmicrobial enzymatic sapstain fungi.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Mississippi are ones valued at more than \$5.9 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Mississippi every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MISSISSIPPI

Several entities in Mississippi also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to the University of Mississippi, which in FY 1998 received close to \$2.5 million, primarily in support of the Atherosclerosis Risk in Communities

(ARIC) program for HHS. In addition, Dimco, Inc. (\$500,000), Sea Probe, Inc. (\$300,000), and Seemann Composites, Inc. (\$300,000), received significant R&D contracts from federal agencies in FY 1998. MSU (\$2 million) and USM (\$300,000) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds these educational institutions receive from federal R&D grants.

A total of \$14 million of federal R&D dollars was also received in FY 1998 by entities located in Mississippi in the form of cooperative agreements. The largest of these cooperative agreements (\$3 million in FY 1998) went from NSF to MSU to operate the Engineering Research Center (ERC) for Computational Field Simulation. Other federal agencies awarding cooperative agreements to Mississippi-based entities include USDA and DOE.

Chapter 26

Federal Research and Development in Missouri

- Approximately \$1.4 billion of federal R&D funds are spent each year in Missouri.
- Missouri ranks 15th among the 50 states, District of Columbia, and the Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 10 percent of all federal funds spent in Missouri each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

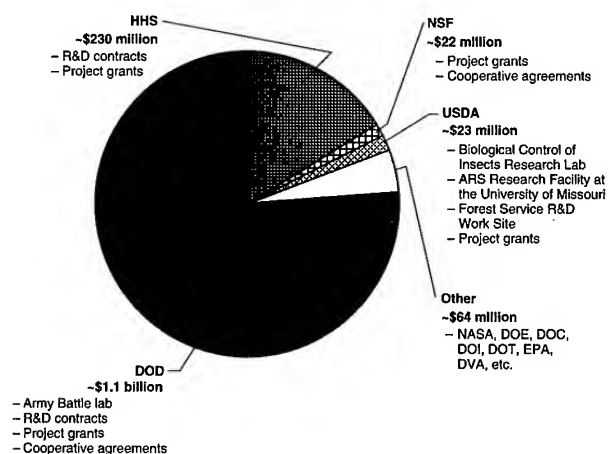


Figure 26.1 – Sources of Federal R&D Dollars Spent in Missouri
(Total Federal R&D ~\$1.4 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$1.4 billion annually in Missouri on research and development (R&D) activities. On average, federal R&D dollars account for approximately 10 percent of all federal funds spent in Missouri each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Missouri. Foremost among these agencies is the Department of Defense (DOD), which provides 76 percent of the federal R&D dollars spent each year in Missouri. The Department of Health and Human Services (HHS) accounts for another 16 percent. The remainder of the federal R&D dollars spent in Missouri each year come from the Department of Agriculture (USDA), the National Science Foundation (NSF), and several other agencies.²⁶

All federal R&D dollars spent in Missouri either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Missouri.

FEDERAL R&D UNITS IN MISSOURI

Columbia, Missouri, is home to USDA's Biological Control of Insects Research Laboratory, Agricultural Research Service (ARS) Research Facility at the University of Missouri, and Forest Service R&D Work Site; the Department of Interior's (DOI) Columbia Environmental Research Center, Columbia Field Station, and Missouri Cooperative Fish and Wildlife Research Unit; and a Department of Veterans Affairs (DVA) R&D unit.

- The Biological Control of Insects Research Laboratory is a unit of USDA's ARS located on the campus of the University of Mis-

²⁶ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

souri. It conducts research on insect pathogens, predators, and parasites for control of insect pests. Specific research activities of this laboratory include improving biological properties, production and stability of microbial control agents and developing methods of in vitro propagation of beneficial insects for biological control. This federal R&D unit, together with the ARS Research Facility described immediately below, annually receives approximately \$5.5 million of federal R&D funds and has about 60 FTEs.

- The ARS Research Facility at the University of Missouri is a unit of USDA's ARS located on the campus of the University of Missouri. It consists of three research divisions focusing on animal physiology, plant genetics, and cropping systems and water quality. One of the divisions conducts research on environmental stress effects on the endocrine and immune systems of neonatal pigs. Activities of this division also include investigation of other factors affecting animal health, such as control of thermoregulation and immune function. The second division conducts research on the molecular genetics of corn; the genetics of wheat; and the breeding of birdsfoot trefoil, leading to improved breeding germplasm and techniques. The third division conducts research on the development of alternative farming systems and technologies to improve water and soil quality. The funding and staffing information for this federal R&D unit are included in those presented above for the Biological Control of Insects Research Laboratory.
- The R&D Work Site is a unit of the North Central Forest Experiment Station inside USDA's Forest Service. This unit is on the campus of the University of Missouri with additional locations in Salem and Jefferson City, Missouri, and Bedford, Indiana. It conducts research on the silviculture and ecology of the upland central hardwood forests. Specific research activities of this unit include investigating ways to regenerate and manage forests to produce forest products, maintain species diversity, and protect neotropical migrant birds. This federal R&D unit

annually receives approximately \$1.6 million of federal R&D funds and has about 24 employees.

- The Columbia Environmental Research Center is a unit of DOI's U.S. Geological Survey (USGS). It conducts research on highly toxic compounds, such as dioxin. Its hazard assessment laboratory permits the investigation of highly toxic chemicals too hazardous to test in a normal laboratory setting. Specific research activities of this center include looking at the cellular, organ, and organismal levels of organization in fish and wildlife; investigating the effects of land use and climate change on Ozarks streams and their ecology; and studying the links between surficial processes and physical habitat in streams and rivers. This federal R&D unit annually receives approximately \$2.9 million of federal R&D funds and has about 62 FTEs.
- The Columbia Field Station is a unit of the Northern Prairie Wildlife Research Center inside DOI's USGS. It is on the Columbia campus of the University of Missouri. It conducts research to develop and evaluate long-term ecological monitoring strategies for grassland units of the National Park System. Specific research activities of this field station include ecological monitoring protocols for macro-invertebrates, plant communities, prairie dogs, butterflies, and other organisms. This federal R&D unit annually receives approximately \$224,000 of federal R&D funds and has about three FTEs.
- The Missouri Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the Columbia campus of the University of Missouri. It conducts research on stream ecology. Specific research activities of this unit include studying fish-habitat and fish-invertebrate interactions and investigating the effects of various perturbations of these vectors on fish and invertebrates. This federal R&D unit annually receives approximately \$287,000 of federal R&D funds and has about three FTEs.

- While the principal focus of the Harry S. Truman Memorial VA Medical Center in Columbia is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 99 projects with total funding of approximately \$850,000. These R&D activities focus on a wide range of topics, including hypertension, cardiovascular diseases, and autoimmune diseases.

Fort Leonard Wood, Missouri, is home to DOD's Maneuver Support Battle Laboratory.

- The Maneuver Support Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. It assesses advances in technologies related to maneuver support, such as terrain visualization, battlefield mobility, and force protection, that may improve future soldier capabilities in any type of operation. Specific research activities of this laboratory focus on such matters as developing digital geospatial data and products; obscurants that deny the enemy the ability to target vehicles; battlefield marking systems; and decision, reconnaissance, and surveillance aids for military police, chemical, and engineer reconnaissance. This federal unit annually receives about \$479,000 of federal R&D funds, only a portion of which is spent in-house, and has six civilian personnel.

Rolla, Missouri, is home to DOI's Mid-Continent Mapping Center and Missouri District Office of Water Resources.

- The Mid-Continent Mapping Center is a unit of DOI's USGS. It is a production, research, and data management facility for maps and digital cartographic data products. Specific research activities of the center's Geographic and Cartographic Research and Applications Section include establishing research and applications partnerships and providing technical assistance and training, including using geographic information and image-

processing systems to better understand environmental and socioeconomic issues. Specific research activities of the center's Earth Science Information Center include collecting, maintaining, and distributing regional cartographic and geographic information and databases. This federal R&D unit annually receives approximately \$1.8 million in federal R&D dollars and has 312 FTEs, 50 of whom are directly involved in R&D.

- The Missouri District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$546,000 in federal R&D funds.

Kansas City and St. Louis, Missouri, are both home to DVA Medical Centers. While the principal focus of the VA Medical Centers in Kansas City and St. Louis is providing medical care to veterans, they are also the location of a number of research activities. In a recent year, these federally owned and operated facilities were the site of 388 projects with total funding of approximately \$6 million. These R&D activities focus on a wide range of topics, including neoplasms, aging, memory, alcoholism, diabetes, radiation, and drug dose-response relationship.

FEDERAL R&D GRANTS TO MISSOURI ENTITIES

Every major institution of higher education in Missouri is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, USDA, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Washington University, the University of Missouri, and St. Louis University (SLU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, USDA, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to Washington University are ones from NASA (\$4 million) and DOE (\$2 million). The comparable grants going to the University of Missouri include \$3 million from the Environmental Protection Agency (EPA), \$2 million each from DOE and the Department of Education, and \$1 million from NASA.

Table 26.1 – Sources of Federal R&D Grants to Higher Education in Missouri

Institution	HHS		NSF		USDA		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Washington	\$201M	761	\$10M	171	<\$1M	12	\$4M	21	\$6M	74	\$221M	1,039
U of Missouri	\$26M	175	\$10M	196	\$8M	255	\$4M	25	\$8M	74	\$57M	725
SLU	\$21M	114	<\$1M	11	0	0	<\$1M	1	<\$1M	8	\$21M	134
Other	\$2M	12	\$1M	19	\$2M	22	0	0	<\$1M	1	\$5M	54
Total	\$249M	1,062	\$21M	397	\$11M	289	\$9M	47	\$14M	157	\$304M	1,952

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the School of Medicine at the University of Missouri.

Several other nonacademic institutions in Missouri also receive a significant amount of federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are Barnes-Jewish Hospital in St. Louis (\$14 million), the Midwest Research Institute in Kansas City (\$4 million), and the Missouri State Department of Health in Jefferson City (\$2 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Missouri received 23 SBIR awards totaling \$6 million. Examples include a \$750,000 award from HHS to JVC Radiology and Medical Analysis in St. Louis to assess doctor and elderly patient encounters and a \$700,000 award from DOD (Air Force) to Kedly, Inc., in High Ridge to develop a portable auditory diagnostic system.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Missouri are ones valued at more than \$6.6 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Missouri every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MISSOURI

Several entities in Missouri also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from DOD to McDonnell Douglas Corporation (now part of the Boeing Company),

which in FY 1998 received close to \$300 million in R&D contracts for such work as development of the F/A-18 fighter and the production of Joint Direct Attack Munition (JDAM) kits. In addition, Light Helicopter Turbine Engine Company (\$33 million), Engineered Air Systems, Inc. (\$13 million), and the Midwest Research Institute (\$7 million) received very large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by the Midwest Research Institute. SLU (\$7 million), Washington University (\$5 million), and the University of Missouri (\$2 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$4 million of federal R&D dollars was also received in FY 1998 by entities in Missouri in the form of cooperative agreements. The largest of these cooperative agreements (\$1 million in FY 1998) came from DOE to Urban Energy and Transport Corp. in Kansas City for work concerning the local impact of hazardous waste transportation. Other federal agencies awarding cooperative agreements to Missouri-based entities include DOD and USDA.

Chapter 27

Federal Research and Development in Montana

- Approximately \$80 million of federal R&D funds are spent each year in Montana.
- Montana ranks 45th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 4 percent of all federal funds spent in Montana each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

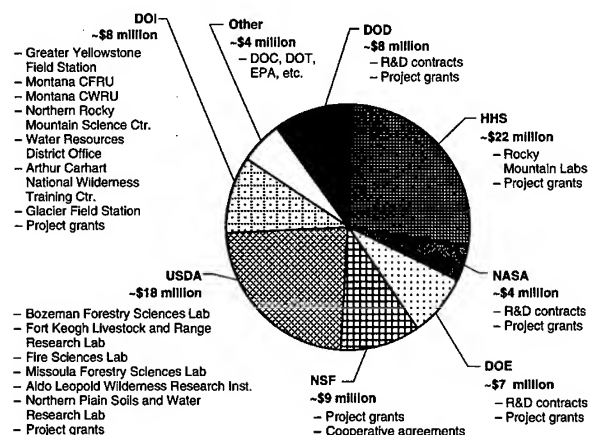


Figure 27.1 – Sources of Federal R&D Dollars Spent in Montana
(Total Federal R&D ~\$80 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$80 million annually in Montana on research and development (R&D) activities. On average, federal R&D dollars account for approximately 4 percent of all federal funds spent in Montana each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Montana. Foremost among these agencies are the Departments of Health and Human Services (HHS) and Agriculture (USDA), which account for 27 and 23 percent of all federal R&D dollars spent in the state. The National Science Foundation (NSF), the Department of Defense (DOD), the Department of Energy (DOE), and the National Aeronautics and Space Administration (NASA) account for additional 11, 10, 8, and 5 percent of federal R&D dollars spent in Montana, respectively. The remaining federal R&D dollars come collectively from the Department of Transportation (DOT), the Environmental Protection Agency (EPA), and several other federal agencies.²⁷

All federal R&D dollars spent in Montana either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Montana.

FEDERAL R&D UNITS IN MONTANA

Bozeman, Montana, is home to the Department of Interior's (DOI's) Greater Yellowstone Field Station, Montana Cooperative Fishery Research Unit, and Northern Rocky Mountain Science Center and USDA's Bozeman Forestry Sciences Laboratory.

²⁷ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

- The Greater Yellowstone Field Station is a unit of the Northern Rocky Mountain Science Center inside DOI's U.S. Geological Survey (USGS). It conducts research in many different disciplines, including wildlife biology, vegetation ecology, wetlands, physical science, biometry, and decision analysis. Specific research activities of this unit include specialized work in population management of key species (e.g., grizzly bears, bison) and for public land management. The Interagency Grizzly Bear Study Team is also part of this field station. Current research projects include large mammal population dynamics and ecology, especially of grizzly bear, bison, and mule deer; vegetation condition and management techniques, especially the effects of fire and wild herbivores; and biodiversity, landscape dynamics, and climate trends, especially through the use of geographic information systems and statistical modeling. This federal R&D unit annually receives approximately \$881,000 of federal R&D funds and has about 19 FTEs.
- The Montana Cooperative Fishery Research Unit is part of DOI's USGS. It is on the campus of Montana State University. It conducts research on fishery resources in the Rocky Mountains and the northern Great Plains. The unit was created to enhance graduate education in fisheries science and facilitate cooperative research among its cooperating entities (the Montana Department of Fish, Wildlife, and Parks, Montana State University, and the National Biological Service). Specific research activities of this field station include studying effects of irrigation withdrawal on stream trout populations, ecology of benthic fishes in large Great Plains rivers, sturgeon reproductive physiology, and alpine lake fishery characteristics. This federal R&D unit annually receives approximately \$176,000 of federal R&D funds and has about two FTEs.
- The Northern Rocky Mountain Science Center is a unit of DOI's USGS. It has field stations in Bozeman, Missoula, and West Glacier. It conducts research to enhance the application of science in the interest of wise natural resource conservation

and land management in decisionmaking. It works closely with the National Park Service, Fish and Wildlife Service, Bureau of Land Management, and other DOI partners and clients on all of its research efforts. This federal R&D unit annually receives approximately \$79,000 of federal R&D funds and has about two FTEs.

- The Bozeman Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. Along with its sister unit in Missoula, it conducts research on forest ecosystem management. Specific research activities in Bozeman include developing information on forest ecosystems and forest health for montane and high-elevation forests. Specific research activities in Missoula include developing silvicultural information for larch, Douglas fir, and ponderosa pine forests. This federal R&D unit annually receives approximately \$1 million of federal R&D funds and has about six employees.

Hamilton, Montana, is home to HHS's Rocky Mountain Laboratories.

- The Rocky Mountain Laboratories are units of the National Institute of Allergy and Infectious Diseases (NIAID) inside HHS's NIH, which is headquartered in Bethesda, Maryland. The specific laboratories that constitute the Rocky Mountain Laboratories include the Laboratory of Microbial Structure and Function, the Laboratory of Intracellular Parasites, the Laboratory of Persistent Viral Diseases, and the Laboratory of Human Bacterial Pathogenesis. The research activities at these laboratories includes studies of the bacteria that cause such human diseases as gonorrhea, plague, Lyme disease, and trachoma; studies of persistent and latent virus infections; and the molecular basis of human epidemics. Much of the research at these laboratories focuses on the development of vaccines. This federal unit annually receives approximately \$5 million of federal R&D funds and has about 101 FTEs.

Helena, Montana, is home to DOI's Montana District Office of Water Resources.

- The Montana District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.3 million in federal R&D funds.

Huson, Montana, is home to DOI's Arthur Carhart National Wilderness Training Center.

- The Arthur Carhart National Wilderness Training Center is a cooperative unit of DOI's Bureau of Land Management, Fish and Wildlife Service, and National Park Service and USDA's Forest Service. It is focused primarily on developing wilderness managers and improving the public's understanding of wilderness. It also works to improve the link between research and education involving wilderness. This federal unit annually receives approximately \$65,000 of federal R&D funds.

Miles City, Montana, is home to USDA's Fort Keogh Livestock and Range Research Laboratory.

- The Fort Keogh Livestock and Range Research Laboratory is a unit of USDA's Agricultural Research Service (ARS). It conducts research on grazing management, beef cattle nutrition, carbon

dioxide source/sink relationships on rangelands, and forage grazing trials. Specific research activities of this lab include studying how plants respond to grazing and environmental stress; identifying the molecular genetic markers associated with traits of economic and biological importance; and investigating ways to optimize reproductive efficiency by determining physiological, metabolic, and endocrine mechanisms controlling calf development and survival from conception to weaning. This federal R&D unit annually receives approximately \$2.2 million of federal R&D funds and has about 21 FTEs.

Missoula, Montana, is home to DOI's Montana Cooperative Wildlife Research Unit, and USDA's Missoula Forestry Sciences Laboratory, Fire Sciences Laboratory, and Aldo Leopold Wilderness Research Institute.

- The Montana Cooperative Wildlife Research Unit is part of DOI's USGS. It is on the campus of the University of Montana. It conducts research on productivity of birds. Specific research activities of this unit include breeding productivity of birds in Arizona, grassland bird production on the Flathead Indian Reservation, and the Bitterroot riparian bird project. This federal R&D unit annually receives approximately \$187,000 of federal R&D funds and has about two FTEs.
- The Missoula Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on ecosystem management. Specific research activities of this lab include developing wildlife habitat information, ecosystem management tools, and econometric models. This federal R&D unit annually receives approximately \$1.6 million of federal R&D funds and has about 39 employees.
- The Fire Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on wildland fire. Specific research activities of this lab include investigating wildland fire behavior, providing practical guides and information system to land managers, and charac-

terizing fuel chemistry in wildfires. This federal R&D unit annually receives approximately \$2.4 million of federal R&D funds and has about 40 employees.

- The Aldo Leopold Wilderness Research Institute is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on wilderness management practices. Specific research activities of this institute include studying the biological and social attributes and benefits of the wilderness. This federal R&D unit annually receives approximately \$834,000 of federal R&D funds from USDA and has about nine FTEs. It also receives an additional \$50,000 of federal R&D funds each year from the Bureau of Reclamation within the Department of Interior.

Sidney, Montana, is home to USDA's Northern Plain Soils and Water Research Laboratory.

- The Northern Plain Soil and Water Research Laboratory is a unit of USDA's ARS. It conducts research on ways to develop and implement ecologically based strategies, technologies, and products for the management of crops and rangeland in sustainable agricultural and natural resource systems. Specific research activities of this unit include looking into soil and water stewardship and development methods for biological and cultural management of insects, pathogens, and weeds. This federal R&D unit annually receives approximately \$3 million of federal R&D funds and has about 27 FTEs.

West Glacier, Montana, is home to DOI's Glacier Field Station.

- The Glacier Field Station is a unit of the Northern Rocky Mountain Science Center inside DOI's USGS. It conducts research on the ecosystem of the Northern Rockies area known as the Northern Continental Divide Ecosystem. This location is ideal for large-scale research because a large portion of the area is protected for future generations. Specific research activities of this field station include studying bear ecology, global climate

change, whitebark and limber pine ecology, mountain landscape ecology, and amphibian ecology. This federal R&D unit annually receives approximately \$565,000 of federal R&D funds and has about nine FTEs.

FEDERAL R&D GRANTS TO MONTANA ENTITIES

Every major institution of higher education in Montana is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by NSF, HHS, DOC, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as Montana State University (MSU) and the University of Montana (including the Montana Tech campus). The table below shows the number of R&D grants active in FY 1998, highlighting those made by NSF, HHS, DOC, and USDA to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to MSU are ones from DOD (\$2 million) and NASA (\$1 million). The comparable grants going to the University of Montana include \$1 million each from DOE and the Department of Education.

Table 27.1 – Sources of Federal R&D Grants to Higher Education in Montana

	NSF		HHS		DOC		USDA		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
MSU	\$5M	61	\$4M	37	\$5M	1	\$2M	139	\$3M	35	\$20M	273
U of Montana	\$2M	33	\$2M	15	0	0	\$1M	24	\$3M	26	\$7M	98
Other	<\$1M	2	0	0	0	0	0	0	<\$1M	7	\$1M	9
Total	\$7M	96	\$6M	52	\$5M	1	\$3M	163	\$6M	68	\$27M	380

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and un-

derstanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Other nonacademic institutions in Montana also receive a significant amount of federal R&D grants each year. Foremost among these institutions in Montana that received R&D grants in FY 1998 are the McLaughlin Research Institute in Great Falls (\$1 million) and Montec Associates, Inc., in Butte (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Montana received 12 SBIR awards totaling \$3 million. Examples include a \$750,000 award from HHS to Montana Immunotech, Inc., in Bozeman to develop a food test for *E. coli* to prevent infections and a \$500,000 award from DOD (Ballistic Missile Defense Organization) to Scientific Materials Corp. in Bozeman for work on improved crystals for optical memories.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Montana are ones valued at more than \$2.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Montana every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN MONTANA

Several entities in Montana also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of the funds go to MSE Technology Applications, Inc., which in FY 1998 received close to \$25 million in R&D contracts, primarily to support a DOE-sponsored effort to test, evaluate, and demonstrate waste treatment technologies. The University of Montana (\$1.5 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$3 million of federal R&D dollars was also received in FY 1998 by entities located in Montana in the form of cooperative agreements. By far the largest of these cooperative agreements (\$2 million in FY 1998) came from NSF to MSU for the support of the Engineering Research Center for Interfacial Microbial Process Engineering. Other federal agencies awarding cooperative agreements to Montana-based entities include USDA and the Department of Interior.

Chapter 28

Federal Research and Development in Nebraska

- Approximately \$93 million of federal R&D funds are spent each year in Nebraska.
- Nebraska ranks 44th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 3 percent of all federal funds spent in Nebraska each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

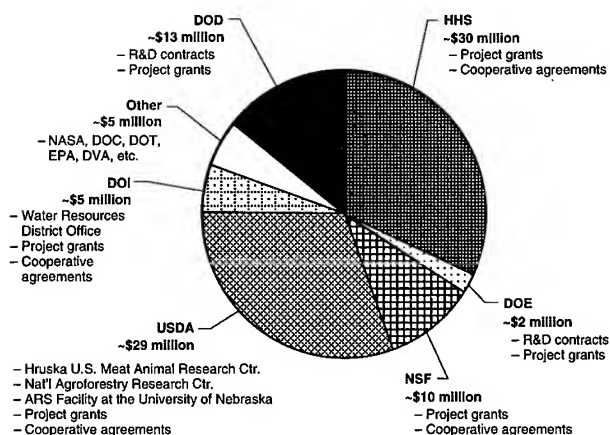


Figure 28.1 – Sources of Federal R&D Dollars Spent in Nebraska
(Total Federal R&D ~\$93 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$93 million annually in Nebraska on research and development (R&D) activities. On average, federal R&D dollars account for approximately 3 percent of all federal funds spent in Nebraska each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Nebraska. Foremost among these agencies are the Departments of Health and Human Services (HHS) and Agriculture (USDA), which account for 32 and 31 percent of all federal R&D dollars spent in the state, respectively. The Department of Defense (DOD), the National Science Foundation (NSF), and the Department of Interior (DOI) account for an additional 14, 10, and 5 percent of all federal R&D dollars spent in Nebraska, respectively. The remaining federal R&D dollars come collectively from the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and several other federal agencies.²⁸

All federal R&D dollars spent in Nebraska either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Nebraska.

FEDERAL R&D UNITS IN NEBRASKA

Clay Center, Nebraska, is home to USDA's Roman L. Hruska U.S. Meat Animal Research Center.

- The Roman L. Hruska U.S. Meat Animal Research Center is a unit of USDA's Agricultural Research Service (ARS). It conducts research to develop new technologies to increase efficiency of production of high-quality red meat. The center is composed of

²⁸ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

seven divisions focusing on nutrition, reproduction, biological engineering, production systems, meats, genetics and breeding, and animal health systems. Some of these divisions conduct research on the efficiency of feeds and developing optimal feeding programs for such animals as sheep and swine that result in multiple births for sheep and high growth potential for swine. Other divisions conduct research to develop new techniques for managing distribution of the waste nutrients and evaluation of new methods for controlling wastes from feedlots and develop and evaluate different systems of livestock production. Still other divisions conduct research on production efficiency, product quality, and product wholesomeness of red meat animals; selection procedures and systems of crossbreeding in all three species of livestock; and integrated programs for controlling diseases and parasites causing losses in beef cattle, sheep, and swine production. These federal R&D units combined receive approximately \$14 million of federal R&D funds and have about 123 FTEs.

Lincoln, Nebraska is home to the USDA's National Agroforestry Research Center and the ARS Facility at the University of Nebraska and DOI's Nebraska District Office of Water Resources.

- The National Agroforestry Research Center is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on the function, design, and installation of forested riparian and upland buffers in the Great Plains. Specific research activities of this center focus on improving the understanding of how forested riparian and upland forest buffers function to protect water and aquatic environments from soil sediments, excess nutrients, and pesticide. The center also conducts site-based studies for improving the ability to design and install these buffer systems under a variety of environmental conditions to meet landowner objectives. This federal R&D unit annually receives approximately \$600,000 in federal R&D funds and has about 18 employees.
- The ARS Facility at the University of Nebraska is a unit of USDA's ARS. It consists of three divisions that focus on soil and

water conservation; wheat, sorghum, and forage; and Midwest livestock insects. These divisions conduct research to improve the productivity, stability of production, sustainability, and profitability of crop and livestock production systems in the Great Plains. Specific research activities include exploring ways to protect Nebraska's groundwater and utilize remote sensing methods for developing better crop management skills. These federal R&D units together receive approximately \$4.8 million of federal R&D funds and have about 50 FTEs.

- The Nebraska District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$826,000 in federal R&D funds.

Omaha, Nebraska, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Omaha VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally

owned and operated facility was the site of 83 projects with total funding of approximately \$2 million. These R&D activities focus on a wide range of topics, including diabetes, lung disorders, radiotherapy, and neoplasms.

FEDERAL R&D GRANTS TO NEBRASKA ENTITIES

Every major institution of higher education in Nebraska is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, USDA, and NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Nebraska system and Creighton University. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, USDA, and NSF to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Nebraska are ones from DOD (\$3 million) and NASA (\$2 million).

Table 28.1 – Sources of Federal R&D Grants to Higher Education in Nebraska

Institution	HHS		USDA		NSF		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Nebraska	\$20M	126	\$7M	318	\$7M	127	\$6M	61	\$40M	632
Creighton	\$3M	29	<\$1M	1	<\$1M	6	<\$1M	5	\$4M	41
Other	0	0	0	0	<\$1M	1	0	0	<\$1M	1
Total	\$23M	155	\$7M	319	\$7M	134	\$7M	66	\$44M	674

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each

year to various academic departments within these institutions, such as the Medical Center at the University of Nebraska.

Several other nonacademic institutions in Nebraska also receive federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are Father Flanagan's Boy's Home in Boys Town (\$6 million), CalEnergy Co. in Omaha (\$600,000), and Mutual of Omaha Insurance Co. in Omaha (\$600,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Nebraska received eight SBIR awards totaling close to \$1 million. These included a \$400,000 award from BMDO to J. A. Woolam Co. in Lincoln for work on spacecraft thermal control management using electrochromics and a \$200,000 award from USDA to Midwest Microsystems in Ainsworth to study rural revitalization through "telework."

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Nebraska are ones valued at more than \$3.2 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Nebraska every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NEBRASKA

Several entities in Nebraska also receive notable sums in the form of contracts or cooperative agreements from federal agencies for spe-

cific R&D efforts. The majority of these funds go to Duncan Aviation, Inc., which in FY 1998 received close to \$17 million from DOD to fund production of C-23 aircraft for the U.S. Army Aviation and Troop Command. In addition, Sterling Software, Inc. (\$10 million), received significant R&D contracts from federal agencies in FY 1998. The University of Nebraska (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come close to eclipsing the funds this institution receives from federal R&D grants.

A total of \$2 million of federal R&D dollars was also received in FY 1998 by entities located in Nebraska in the form of cooperative agreements. The largest of these cooperative agreements (\$1 million in FY 1998) came from NSF to the University of Nebraska at Lincoln to fund EPSCoR (Experimental Program to Stimulate Competitive Research) activities. Other federal agencies awarding cooperative agreements to Nebraska-based entities include USDA and the Department of Interior.

Chapter 29

Federal Research and Development in Nevada

- Approximately \$380 million of federal R&D funds are spent each year in Nevada.
- Nevada ranks 27th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 14 percent of all federal funds spent in Nevada each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

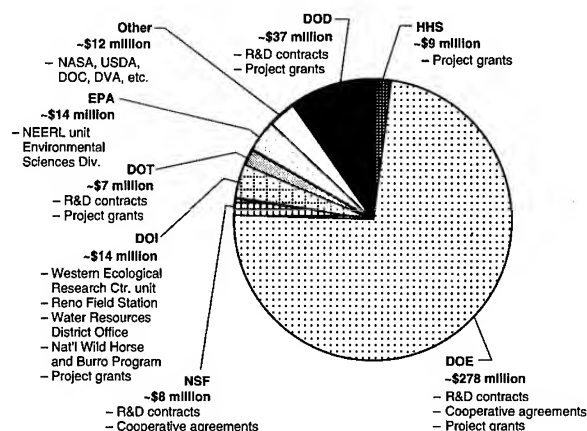


Figure 29.1 – Sources of Federal R&D Dollars Spent in Nevada
(Total Federal R&D ~\$380 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$380 million annually in Nevada on research and development (R&D) activities. On average, federal R&D dollars account for approximately 14 percent of all federal funds spent in Nevada each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Nevada. Foremost among these agencies is the Department of Energy (DOE), which accounts for 73 percent of all federal R&D dollars spent in the state. The Department of Defense (DOD), the Environmental Protection Agency (EPA), and the Department of Interior (DOI) account for an additional 10, 4, and 4 percent of all federal R&D dollars spent in Nevada, respectively. The remaining federal R&D dollars come collectively from the National Science Foundation (NSF), the Department of Transportation (DOT), and several other federal agencies.²⁹

All federal R&D dollars spent in Nevada either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Nevada.

FEDERAL R&D UNITS IN NEVADA

Carson City, Nevada, is home to DOI's Nevada District Office of Water Resources.

- The Nevada District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs.

²⁹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$2.3 million in federal R&D funds.

Las Vegas, Nevada, is home to a unit of DOI's Western Ecological Research Center.

- The Las Vegas Field Station is a unit of the Western Ecological Research Center inside DOI's USGS. It conducts research on the plants and animals that occur at the margins of the geographic and physiological limits of the ecotone between the Mojave, Great Basin, and Sonoran deserts and are challenged by rapid urban growth. Specific research activities of this field station include studying the translocation, reproduction, density estimation, and monitoring of the desert tortoise; effects of fire and invasive plants on Sonoran and Mojave desert ecosystems; and effects of increased atmospheric carbon dioxide on Mojave Desert vegetation. This federal R&D unit annually receives approximately \$230,000 of federal R&D funds and has about two FTEs.

Reno, Nevada, is home to USDA's Reno Forestry Sciences Laboratory and Landscape Ecology of Temperate Desert Rangelands Laboratory, DOI's Reno Field Station and National Wild Horse and Burro Program, EPA's Environmental Sciences Division, and a Department of Veterans Affairs (DVA) R&D unit.

- The Reno Forestry Science Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on woodland ecology and ecosystem management. Specific research activities of this lab include developing woodland classification schemes, determining ecological relationships in Great Basin piñon and juniper woodland ecosystems, and evaluating site responses to management alternatives. This federal R&D unit annually receives approximately \$464,000 in federal R&D funds and has about five employees.
- The Landscape Ecology of Temperate Desert Rangelands Laboratory is a unit of USDA's Agricultural Research Service (ARS). It conducts research on exotic and invasive weeds and local wildlife to develop the best strategies for establishing native plants on the range. Specific research activities of this unit include finding, studying, and releasing organisms that will control weed activity. The funds supporting this federal R&D unit are included in those detailed for the laboratory headquarters in Albany, California. It has about six employees.
- The Reno Field Station is a unit of the Western Fisheries Research Center inside DOI's USGS. It conducts research on fish population viability. The laboratory investigates the influence of water manipulation, habitat modification, and nonindigenous fish introduction on native fish populations. Specific research activities of this field station include population dynamics, basic life history, interspecific interactions between native and introduced species, and status and trends of threatened and endangered fishes. This federal R&D unit annually receives approximately \$129,000 of federal R&D funds and has about two full-time equivalent employees (FTEs).
- The National Wild Horse and Burro Program is a unit of DOI's Bureau of Land Management, dedicated to the management, protection, and control of wild horses and burros. In FY 1998, this federal unit received approximately \$50,000 of federal R&D funds to support research in furtherance of this objective.

- The Environmental Sciences Division is a unit of EPA's National Exposure Research Laboratory headquartered in Research Triangle Park, North Carolina. It conducts research, development, and technology transfer programs on environmental exposures to ecological and human receptors. The division develops methods for characterizing chemical and physical stressors, with special emphasis on ecological exposure. It also develops landscape and regional assessment capabilities through the use of remote sensing and advanced spatial analysis techniques. In addition, the division conducts analytical chemistry research and applies advanced monitoring technology to issues involving surface and subsurface contamination. This federal R&D unit annually receives approximately \$17.2 million in federal R&D funds and has about 77 FTEs.
- While the principal focus of the VA Sierra Nevada Health Care System facility, the VA Medical Center in Reno, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 87 projects with total funding of approximately \$280,000. These R&D activities focus on a wide range of topics, including stress disorders, neurology, oncology, and cardiology.

FEDERAL R&D GRANTS TO NEVADA ENTITIES

Every major institution of higher education in Nevada is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOE to individual faculty members and therefore ultimately inure to the benefit of the University and Community College System of Nevada (UCCSN). The UCCSN consists of the University of Nevada at Las Vegas, the University of Nevada at Reno, four community colleges, and the Desert Research Institute. Because the Desert Research Institute is primarily a research, not an educational, entity, grants pro-

vided to it are listed separately. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOE to parties at UCCSN and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. The grants in the "Other Agencies" category going to the UCCSN include \$2 million from USDA and \$1 million from DOD, and most of the remainder is distributed among EPA, NASA, and the Department of Justice.

Table 29.1 – Sources of Federal R&D Grants to Higher Education in Nevada

	HHS		NSF		DOE		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
UCCSN	\$8M	37	\$6M	105	\$5M	16	\$4M	140	\$23M	298

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Nevada also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Desert Research Institute in Reno (\$3 million), the National Council of Juvenile and Family Court Judges in Reno (\$2 million), and the Sierra Biomedical Research Corporation in Reno (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Nevada received seven SBIR awards totaling \$2 million. Examples include a \$750,000 award from the Air Force to Johnson Rockets in Carson City to develop rocket engine analysis codes and a

\$600,000 award from the Navy to Opticomp Corp. in Zephyr Cove for work on volume photorefractive optical interconnect elements for C3I applications.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Nevada are ones valued at more than \$1.2 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Nevada every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NEVADA

Several entities in Nevada also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to Bechtel, which annually receives approximately \$250 million to support the R&D activities taking place at the Nevada Test Site. The site is a massive outdoor facility that hosts some of the riskiest R&D experiments conducted by federal agencies. Specific R&D activities that take place at the site include hazardous chemical spill experiments, emergency response studies, conventional weapons testing, and waste management and environmental technology studies. Some parts of DOE do not consider any of the approximately \$300 million it provides annually to this site to be federal R&D dollars. This information is included in this report, however, because tens of millions of federal R&D dollars from DOD, NASA, EPA, and other federal agencies are annually spent at the site to cover the costs of conducting federal R&D experiments. Another sizable contract goes to UCCSN, which in FY 1998 received close to \$9 million in R&D contracts, primarily for work on a DOE contract

related to nonproliferation and verification R&D. In addition, Hodges Transportation, Inc. (\$2 million), GPS Solutions, Inc. (\$2 million), and Sierra Nevada Corp. (\$2 million) also received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies.

A total of \$7 million of federal R&D dollars was also received in FY 1998 by entities located in Nevada in the form of cooperative agreements. The largest of these cooperative agreements (\$2.8 million in FY 1998) came from DOC (NOAA) to UCCSN for its management of the Cooperative Institute for Atmospheric Sciences and Terrestrial Applications (CIASTA). Other federal agencies awarding cooperative agreements to Nevada-based entities include DOE and the Department of Justice.

Chapter 30

Federal Research and Development in New Hampshire

- Approximately \$270 million of federal R&D funds are spent each year in New Hampshire.
- New Hampshire ranks 33rd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 13 percent of all federal funds spent in New Hampshire each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

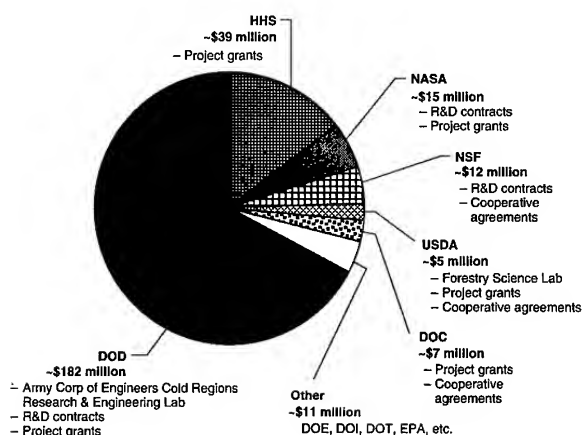


Figure 30.1 – Sources of Federal R&D Dollars Spent in New Hampshire
(Total Federal R&D ~\$270 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$270 million annually in New Hampshire on research and development (R&D) activities. On average, federal R&D dollars account for approximately 13 percent of all federal funds spent in New Hampshire each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in New Hampshire. Foremost among these agencies is the Department of Defense (DOD), which accounts for 67 percent of all federal R&D dollars spent in the state. The Department of Health and Human Services (HHS), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF) account for an additional 14, 6, and 4 percent of all federal R&D dollars spent in New Hampshire, respectively. The remaining federal R&D dollars come collectively from the Department of Commerce (DOC), the Department of Agriculture (USDA), and several other federal agencies.³⁰

All federal R&D dollars spent in New Hampshire either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in New Hampshire.

FEDERAL R&D UNITS IN NEW HAMPSHIRE

Durham, New Hampshire, is home to USDA's Forestry Science Laboratory.

- The Forestry Science Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on forest modeling and ecosystem dynamics. Specific re-

³⁰ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

search activities of this lab include developing, testing, and implementing techniques to analyze the effects of environmental factors on forest ecosystems and investigating environmental concerns in New England forests and streams including nitrogen saturation and cation depletion. This federal R&D unit annually receives approximately \$2.8 million of federal R&D funds and has about 50 employees.

Hanover, New Hampshire, is home to DOD's Cold Regions Research and Engineering Laboratory.

- The Cold Regions Research and Engineering Laboratory is a unit of the Engineer Research and Development Center within DOD's U.S. Army Corps of Engineers. This center is headquartered in Vicksburg, Mississippi, with related units in Champaign-Urbana, Illinois, and Alexandria, Virginia. It conducts R&D on all aspects of the cold/winter environment and its implications for military activities in garrison or on the battlefield, with the single exception of individual soldier clothing and equipment. It also studies the nation's winter water resources through the Civil Works program of the Corps of Engineers. This federal facility annually receives approximately \$20 million of federal R&D funds, most of which is spent on in-house activities, and has about 297 civilian personnel.

Manchester, New Hampshire, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Manchester VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of nine projects with total funding of approximately \$550,000. These R&D activities focus on a wide range of topics, including posttraumatic stress disorder, general behavioral disorders, and psychophysiology.

Pembroke, New Hampshire, is home to DOI's New Hampshire District Office of Water Resources.

- The New Hampshire District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit, in combination with the Vermont District Office, annually receives approximately \$954,000 in federal R&D funds.

FEDERAL R&D GRANTS TO NEW HAMPSHIRE ENTITIES

Every major institution of higher education in New Hampshire is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, NASA, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Dartmouth College and the University of New Hampshire (UNH). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, NASA, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of New Hampshire are ones from DOC (\$2 million), USDA (\$2 million), and

the Department of Justice (\$1 million). Most of the comparable grants going to Dartmouth are from EPA.

Table 30.1 – Sources of Federal R&D Grants to Higher Education in New Hampshire

	HHS		NSF		NASA		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Dartmouth	\$33M	172	\$6M	96	\$1M	25	\$1M	11	\$1M	9	\$42M	313
UNH	\$2M	20	\$5M	74	\$5M	100	\$3M	4	\$6M	122	\$21M	320
Other	<\$1M	2	<\$1M	4	<\$1M	1	0	0	<\$1M	2	<\$1M	9
Total	\$36M	194	\$11M	174	\$6M	126	\$4M	15	\$7M	133	\$64M	642

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in New Hampshire also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Creare, Inc., in Hanover (\$1 million), the New Hampshire State Department of Health and Human Services in Concord (\$700,000), and Metabolic Solutions, Inc., in East Merrimack (\$700,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in New Hampshire received 38 SBIR awards totaling close to \$10 million. Examples include a \$750,000 award from HHS to Bio-Concept Laboratories in Salem for work on metabolic enhancement of contact lens preservatives and a \$750,000 award from DOD (Air Force) to Creare, Inc., in Hanover to develop a freeze-tolerant, lightweight, flexible radiator.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting New Hampshire are ones valued at more than \$1.5 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in New Hampshire every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NEW HAMPSHIRE

Several entities in New Hampshire also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from DOD to Lockheed Sanders (a Lockheed Martin company), which in FY 1998 received close to \$128 million in support of such efforts as the Advanced Threat Infrared Countermeasure/Common Missile Warning System program (ATIRCM/CMWS) for the Army and the Integrated Defensive Countermeasures/Radio Frequency Countermeasures (DECM/RFCM) program for the Navy. In addition, Creare, Inc. (\$10 million), Sonetech Corp. (\$4 million), Telzen K.K. (\$2 million), Dynatech Tactical Communications Corp. (\$1 million), and Alacron, Inc. (\$1 million), received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Creare. UNH (\$1 million) and Dartmouth College (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$6 million of federal R&D dollars was also received in FY 1998 by entities located in New Hampshire in the form of cooper-

ative agreements. The largest of these cooperative agreements (\$2 million in FY 1998) came from DOC to UNH to develop instrumentation for measuring wind profiles from space. Other federal agencies awarding cooperative agreements to New Hampshire-based entities include DOD and USDA.

Chapter 31

Federal Research and Development in New Jersey

- Approximately \$1.5 billion of federal R&D funds are spent each year in New Jersey.
- New Jersey ranks 14th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 10 percent of all federal funds spent in New Jersey each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

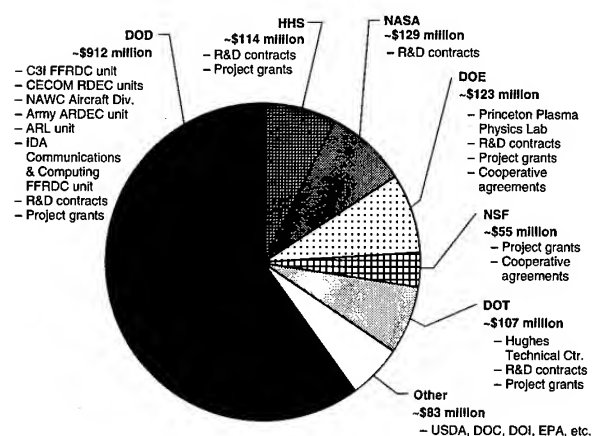


Figure 31.1 – Sources of Federal R&D Dollars Spent in New Jersey
(Total Federal R&D ~\$1.5 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$1.5 billion annually in New Jersey on research and development (R&D) activities. On average, federal R&D dollars account for approximately 10 percent of all federal funds spent in New Jersey each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in New Jersey. Foremost among these agencies is the Department of Defense (DOD), which accounts for about 60 percent of all federal R&D dollars spent in the state. The National Aeronautics and Space Administration (NASA) and the Departments of Energy (DOE), Health and Human Services (HHS), Transportation (DOT), and the National Science Foundation (NSF), account for an additional 8, 8, 7, 7, and 4 percent of the federal R&D dollars spent in New Jersey, respectively. The remaining federal R&D dollars come collectively from the Departments of Agriculture (USDA) and Commerce (DOC) and several other federal agencies.³¹

All federal R&D dollars spent in New Jersey either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities located in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in New Jersey.

FEDERAL R&D UNITS IN NEW JERSEY

Atlantic City, New Jersey, is home to DOT's William J. Hughes Technical Center.

- The William J. Hughes Technical Center is a unit inside DOT's Federal Aviation Administration (FAA). The center maintains and operates the FAA's laboratories that conduct R&D to reduce the number of airplane accidents, improve airspace design, in-

³¹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

crease airport capacity, and reduce airplane delays caused by weather and system outages. The center also develops and tests aviation software systems and equipment and evaluates existing systems. This federal unit annually receives approximately \$11 million in federal R&D funds and has about 1,500 employees, about 15 percent of whom are directly involved in R&D activities.

East Orange, New Jersey, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the East Orange campus of the VA New Jersey Health Care System facility, the VA Medical Center in East Orange, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 351 projects with total funding of approximately \$2.3 million. These R&D activities focus on a wide range of topics, including drug therapy, neoplasms, radiotherapy, HIV, schizophrenia, and substance dependence.

Eatontown, New Jersey, is home to the headquarters and three directorates of DOD's Army Communications-Electronics Command Research, Development, and Engineering Center, a small portion of DOD's Command, Control, Communications, and Intelligence Federally Funded Research and Development Center (FFRDC), and a unit of the Army Research Laboratory.

- The Headquarters of the Army's Communications-Electronics Command (CECOM) Research, Development, and Engineering Center is a unit of DOD. It oversees and coordinates all the R&D activities of CECOM, which focus on information technologies and integrated systems for U.S. warfighters. This federal unit annually receives about \$23 million of federal R&D funds, approximately \$7.3 million of which is spent on in-house activities, and has about 91 FTEs, only a portion of whom are directly involved in R&D activities.

- The Space and Terrestrial Communications Directorate is a unit of the Army's Communications-Electronics Command Research, Development, and Engineering Center inside DOD. The center conducts R&D on information technologies and integrated systems for U.S. warfighters. It is headquartered in Fort Monmouth, New Jersey, with an additional location in Fort Belvoir, Virginia. The Space and Terrestrial Communications Directorate R&D activities include developing and integrating secure seamless tactical communications for the digitized battlefield, providing technical support to program executive officers and project managers for communications systems development and fielding, and acting as a focal point for space-dependent/space-based communications systems. This federal unit annually receives approximately \$48.6 million of federal R&D funds, approximately \$15.3 million of which is spent on in-house activities, and has about 272 FTEs, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Intelligence and Information Warfare Directorate is a unit of the Army's Communications-Electronics Command Research, Development, and Engineering Center inside DOD. The center conducts R&D on information technologies and integrated systems for U.S. warfighters. It is headquartered in Fort Monmouth, with an additional location in Fort Belvoir, Virginia. The Intelligence and Information Warfare Directorate R&D activities include development, production, and fielding of specified equipment in support of Army and national intelligence requirements and law enforcement agencies. This federal unit annually receives about \$33.9 million of federal R&D funds, approximately \$6.4 million of which is spent on in-house activities, and has about 201 FTEs, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Command and Control Directorate is a unit of the Army's Communications-Electronics Command Research, Development, and Engineering Center inside DOD. This unit serves as the lead directorate within the CECOM Research, Development and Engineering Center. The center conducts R&D on information technologies and integrated systems for U.S. warfighters. It is headquartered in Fort Monmouth, with an additional location in Fort Belvoir, Virginia. The Command and Control Directorate develops, integrates, and demonstrates advanced command and control systems and related enabling technologies. Research activities include prototype development and development of battlefield visualization, navigation, power generation, and environmental control technologies. The research areas extend to a variety of aircraft, shelter, vehicular, and soldier platforms. This federal unit annually receives about \$55.5 million of federal R&D funds, approximately \$16 million of which is spent in-house, and has about 385 FTEs, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Command, Control, Communications, and Intelligence Federally Funded Research and Development Center (FFRDC) is sponsored by the Office of the Secretary of Defense and operated by the MITRE Corporation. It conducts R&D on command, control, communications, and intelligence systems for DOD and the intelligence community. The center has three divisions, the Center for Air Force Integrated Intelligence Systems, the Center for Integrated Intelligence Systems, and the C3 Center. This latter division is in McLean, Virginia. The first division provides the Air Force, most especially the Electronic Systems Center, with comprehensive command and control knowledge, expertise, and experience. The R&D of the second division focuses on developing concepts for intelligence activities, enhancing architectures for information management, and engineering intelligence systems. The combined divisions of this federally owned and contractor-operated facility annually

receive about \$180 million of federal R&D funds and employ approximately 1,450 people. About 100 of these employees are at MITRE's Fort Monmouth facility.

- The Fort Monmouth Facility is a unit of DOD's Army Research Laboratory. The laboratory is headquartered in Adelphi, Maryland, with additional sites in Aberdeen, Maryland; White Sands, New Mexico; Cleveland, Ohio; Hampton, Virginia; and Atlanta, Georgia. This specific unit conducts research on information warfare. This federal unit annually receives about \$3.7 million of federal R&D funds, approximately \$2.6 million of which is spent on in-house activities, and has about 18 civilians personnel.

Highlands, New Jersey, is home to the DOC's Sandy Hook Laboratory.

- The Sandy Hook Laboratory, also known as the James J. Howard Marine Science Laboratory, is a unit of the Northeast Fisheries Science Center inside DOC's NOAA. It conducts research in ecology with subdivisions in fishery ecology, environmental chemistry, and aquaculture. This federal unit annually receives approximately \$3.7 million of federal R&D funds and has about 54 FTEs, only a portion of whom are involved in R&D activities.

Lakehurst, New Jersey, is home to DOD's Naval Air Warfare Center Aircraft Division at Lakehurst.

- The Naval Air Warfare Center Aircraft Division at Lakehurst is a unit of DOD. The center is headquartered in Patuxent, Maryland. This unit designs, evaluates, and engineers the aircraft platform interfaces that enable aircraft to operate from aircraft carriers, helicopters from aviation ships, and Marine aircraft from expeditionary airfields. The R&D activities of the center focus on electromagnetic aircraft launch systems, virtual imaging systems for approach and landing, infrared aircraft tracking, and aircraft recognition systems. This federal unit annually receives approximately \$71 million of federal R&D funds and has about 1,800 civilian personnel, only a portion of whom are

directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Picatinny, New Jersey, is home to DOD's Armament Research, Development, and Engineering Center.

- The Armament Research, Development, and Engineering Center is a unit of DOD. It is the research center within the U.S. Army Tank-Automotive and Armaments Command responsible for armaments. It is headquartered in Picatinny with subordinate research activities in Rock Island, Illinois; Watervliet, New York; and Aberdeen, Maryland. It is the center for integrating complex armament technologies into guns, ammunition, and fire control systems through research, development, acquisition, and sustainment. The center conducts research into direct and indirect fire lethality, rapid force projection initiatives, rapid digitized fire missions, innovative weapon concepts, sustainment and survivability, enabling technologies, such as environmental technologies as "green" ammunition, and dual-use technologies. This federal unit annually receives approximately \$131 million of federal R&D funds and has about 2,704 civilian personnel, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Princeton, New Jersey, is home to a unit of DOD's Institute for Defense Analyses Communications and Computing FFRDC, DOE's Princeton Plasma Physics Laboratory, and DOC's Geophysical Fluid Dynamics Laboratory.

- The Center for Communications Research is one of three units constituting the Institute for Defense Analyses Communications and Computing FFRDC. This FFRDC, which is nominally headquartered in Alexandria, Virginia, is sponsored by the National Security Agency and operated by the Institute for Defense Analyses (IDA). The Center for Communications Research in Princeton works closely with its sister unit in La Jolla, Califor-

nia, to conduct mathematical research to support cryptography and cryptanalysis. These two units also conduct R&D on speech and special signals-processing techniques. Together with the Center for Computing Sciences in Bowie, Maryland, the three units of this federally owned and contractor-operated R&D center annually receive approximately \$35 million of core funding, all of which is federal R&D funds, and have about 150 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Princeton Plasma Physics Laboratory is an FFRDC sponsored by DOE and operated by Princeton University. It conducts magnetic confinement experiments utilizing the tokamak approach. The laboratory's researchers investigate advanced fusion devices, such as the National Spherical Torus Experiment, and apply knowledge gained in fusion research to a number of theoretical and experimental areas, including materials science, solar physics, chemistry, and manufacturing. This federally owned and contractor-operated laboratory annually receives approximately \$55 million of core funding and conducts an estimated \$47 million of specific R&D projects. The laboratory has about 400 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Geophysical Fluid Dynamics Laboratory is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts research to expand the scientific understanding of the physical processes that govern the behavior of the atmosphere and the oceans as complex fluid systems. The laboratory conducts research on the predictability of weather patterns, the stability of regional and global climate, and the interaction between the atmosphere and the oceans. This federal unit annually receives approximately \$13.6 million of federal R&D funds and has about 84 FTEs.

West Trenton, New Jersey, is home to the Department of Interior's (DOI's) New Jersey District Office of Water Resources.

- The New Jersey District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$2.7 million in federal R&D funds.

FEDERAL R&D GRANTS TO NEW JERSEY ENTITIES

Every major institution of higher education in New Jersey is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Rutgers University, Princeton University, the University of Medicine and Dentistry of New Jersey (UMDNJ), New Jersey Institute of Technology (NJIT), and Stevens Institute of Technology (SIT). The table below shows the total number of R&D grants active in FY 1998, highlighting those made by HHS,

NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to Rutgers are \$6 million from USDA and close to \$2 million each from DOC, DOE, and NASA. The comparable grants going to Princeton include \$7 million from DOE and \$3 million from NASA. Both UMDNJ and NJIT receive most of the grants included in this category from the Environmental Protection Agency (EPA).

Table 31.1 – Sources of Federal R&D Grants to Higher Education in New Jersey

	HHS		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Rutgers	\$27M	170	\$20M	303	\$6M	48	\$14M	248	\$68M	769
Princeton	\$23M	118	\$21M	278	\$11M	63	\$11M	101	\$67M	560
UMDNJ	\$49M	237	\$1M	9	<\$1M	2	\$2M	10	\$52M	258
NJIT	0	0	\$2M	53	<\$1M	7	\$4M	19	\$6M	79
SIT	0	0	\$1M	18	\$1M	10	<\$1M	6	\$3M	34
Other	\$1M	8	<\$1M	11	<\$1M	1	<\$1M	15	\$1M	35
Total	\$99M	533	\$46M	672	\$19M	131	\$32M	399	\$197M	1,735

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as UMDNJ's Robert Wood Johnson Medical School.

Several other nonacademic institutions in New Jersey also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Center for Molecular Medicine and Immunology (now Garden State Cancer Center) in Belleville (\$6 million); the Institute for Advanced Study in Princeton (\$6 million); the New Jersey State Department of Health and Senior Services in Trenton (\$5 million); Mathematica Policy Research, Inc., in Princeton (\$5 million); and the Coriell Institute for Medical Research in Camden (\$3 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in New Jersey received 119 SBIR awards totaling \$29 million. Examples include a \$1 million award from DOD (Ballistic Missile Defense Organization) to Skion Corp. in Hoboken to develop a superhigh-brightness cold cathode field emitter for flat panel display applications and a \$200,000 award from the U.S. Department of Agriculture (USDA) to Continuum Dynamics, Inc., in Princeton for work on smart helicopter buckets for fire fighting.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting New Jersey are ones valued at more than \$2.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from the USGS inside DOI to the Water Resources Research Institute in New Jersey every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NEW JERSEY

Several entities in New Jersey also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to Lockheed Martin Corporation for work that includes development of communications and experimental spacecraft for NASA and support for the DOD Roving Sands exercise (a total of \$141 million in FY 1998). In addition, Computer Sciences Corporation (\$33 million), Sarnoff Corporation (\$32 million), MacGregor Inc. (\$17 million), and ITT In-

dustries (\$16 million) received large R&D contracts from federal agencies in FY 1998. Princeton University (\$5 million), UMDNJ (\$4 million), Rutgers University (\$2 million), and SIT (\$2 million), also received contracts from various federal agencies in FY 1998 to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$20 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities in New Jersey. The largest of these cooperative agreements (\$4 million) came from DOE to UMDNJ. The next-largest cooperative agreement (\$3 million) came from NSF to Princeton University to support the Borexino solar neutrino experiment. Other federal agencies awarding cooperative agreements to New Jersey-based entities include NSF, DOC, and DOD. Among these latter cooperative agreements are awards supporting one of NSF's Science and Technology Centers—the Center for Discrete Mathematics and Theoretical Computer Science at Rutgers University. In addition, New Jersey is home to one of the NSF's Materials Research Science and Engineering Centers—the Center for Complex Materials at Princeton University.

Chapter 32

Federal Research and Development in New Mexico

- Approximately \$2.3 billion of federal R&D funds are spent each year in New Mexico.
- New Mexico ranks 13th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 29 percent of all federal funds spent in New Mexico each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

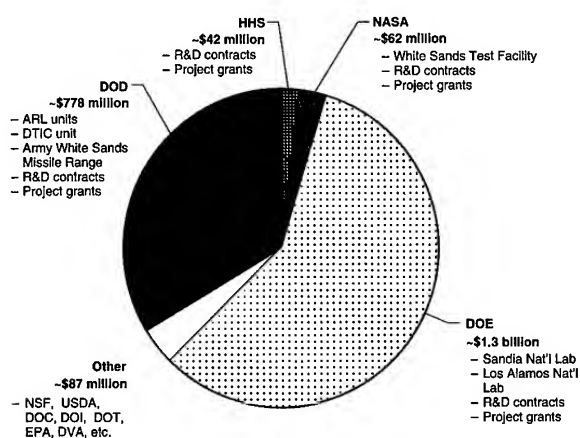


Figure 32.1 – Sources of Federal R&D Dollars Spent in New Mexico
(Total Federal R&D ~\$2.3 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$2.3 billion annually in New Mexico on research and development (R&D) activities. On average, federal R&D dollars account for approximately 29 percent of all federal funds spent in New Mexico each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts fund significant R&D activities in New Mexico. Foremost among these agencies is the Department of Energy (DOE), which accounts for 58 percent of all federal R&D dollars spent in the state. The Department of Defense (DOD) accounts for an additional 34 percent of the federal R&D dollars spent in New Mexico. The remaining federal R&D dollars come collectively from the National Aeronautics and Space Administration (NASA), the Department of Health and Human Services (HHS), the National Science Foundation (NSF), and other federal agencies.³²

All federal R&D dollars spent in New Mexico either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in New Mexico.

FEDERAL R&D UNITS IN NEW MEXICO

Albuquerque, New Mexico, is home to a part of DOD's Air Force Research Laboratory Space Vehicles Directorate and Air Force Research Laboratory Directed Energy Directorate, and the Southwestern Regional Office of the Defense Technical Information Center; DOE's Sandia National Laboratories; the U.S. Department of Agriculture's (USDA's) Albuquerque Forestry Sciences Laboratory; Department of Interior's (DOI's) Arid Lands Field Station, Seismological Laboratory, and

³² For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

New Mexico District Office of Water Resources; and a Department of Veterans Affairs (DVA) R&D unit.

- The Space Vehicles Directorate is a unit of DOD's Air Force Research Laboratory. It is headquartered at Kirtland Air Force Base in New Mexico, with an additional site in Boston, Massachusetts. It develops technologies to control and exploit space. The primary research areas focus on the battlespace environment, protection of space assets, space vehicle control, space-based sensing, space vehicle technologies, and wargaming. This federal unit annually receives approximately \$149 million of federal R&D funds, only about 10 percent of which is spent on in-house R&D activities, and has about 295 civilian personnel, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Directed Energy Directorate is a unit of DOD's Air Force Research Laboratory. It is responsible for the development of photonics and directed energy technologies for air and space applications. The main focus of this unit is on technologies related to the generation and propagation of high-power microwaves, lasers, precision adaptive optics, and remote target imaging and identification. This federal unit annually receives approximately \$88 million of federal R&D funds, only about 10 percent of which is spent on in-house R&D activities, and has about 408 civilian personnel, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Southwestern Regional Office of the Defense Technical Information Center (DTIC) contributes to the R&D efforts by providing access to and facilitating the exchange of scientific and technical information. Specifically, DTIC concentrates on providing information on planned, ongoing, and completed DOD-related R&D to federal agencies and their contractors. This fed-

eral unit annually receives approximately \$150,000 of federal R&D funds and employs about two people.

- The Sandia National Laboratories are a federally funded research and development center (FFRDC) sponsored by DOE and operated by the Sandia Corporation, a subsidiary of Lockheed Martin. Most of the laboratories' activities focus on implementing the nation's nuclear weapons policies by conducting R&D on nuclear weapons, arms control, and weapon surety. Other R&D activities focus on the safe storage, processing, transport, and disposal of hazardous wastes (including radioactive waste), and increasing the efficiency and supply of energy. The laboratories maintain a small facility in Livermore, California, in addition to their large headquarters facility in Albuquerque. These federally owned and contractor-operated laboratories annually receive approximately \$1 billion of core funding, all of which is spent on specific R&D projects, and employ 6,600 people in Albuquerque and 890 people in Livermore, California. A portion of the laboratories' funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Albuquerque Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on ecosystems and wildlife sustainability. Specific research activities of this lab include developing new methods and knowledge to restore damaged systems and recover sensitive and endangered species, maintaining the sustainability of grassland and riparian ecosystems in the Southwest, and research cultural heritage of Northern New Mexico. This federal R&D unit annually receives approximately \$1.5 million in federal R&D funds and has about 14 employees.
- The Arid Lands Field Station is a unit of the Mid-Continent Ecological Science Center inside DOI's U.S. Geological Survey (USGS). It is on the campus of the University of New Mexico. It conducts research on natural resource and wildlife issues in the Southwest and provides baseline inventory and survey information for federal lands, including national parks and

wildlife refuges. Specific research activities of this unit include species and population studies on southwestern amphibians, reptiles, birds, and mammals (especially bats). This federal R&D unit annually receives approximately \$202,000 of federal R&D funds and has about five FTEs.

- The Seismological Laboratory, a unit of DOI's USGS, develops, tests, and evaluates a variety of seismic instrumentation. It also installs and maintains a global network of seismograph stations, collecting and distributing the data produced by these stations. The instruments developed by this laboratory include seismograph instruments, such as strong-motion recorders; portable field equipment for recording explosions and after-shocks; test facilities, such as shaking tables; tsunami-warning systems for Alaska, Hawaii, and the Pacific; local telemetered seismograph networks; and digital data systems for global and regional networks. This federally owned and operated facility annually receives approximately \$4 million of federal R&D funds and has a staff of about 40 people.
- The New Mexico District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.4 million in federal R&D funds.

- While the principal focus of the New Mexico VA Health Care System Facility, the VA Medical Center in Albuquerque, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 236 projects with total funding of approximately \$600,000. These R&D activities focus on a wide range of topics, including schizophrenia, magnetic resonance imaging (MRI), and cerebrovascular disorders. In addition, the center has joined with Los Alamos National Laboratory to pioneer the development and clinical application of the magnetoencephalography unit.

Las Cruces, New Mexico, is home to NASA's White Sands Test Facility, USDA's Jornada Experimental Range, and DOI's New Mexico Cooperative Fish and Wildlife Research Unit.

- White Sands Test Facility is part of NASA's Johnson Space Center in Houston, Texas. It conducts research on the properties and behavior of metallic and nonmetallic materials under aerospace conditions and evaluates the behavior of rocket propulsion systems under simulated space-vacuum conditions. The facility has extensive capabilities for creating space-simulated vacuum conditions for use in research and testing. As a result, it has also played a major role in developing the components and systems used in the Apollo, Skylab, Viking, and Space Shuttle Programs. This federal facility annually receives a total of approximately \$40 million and has a staff of about 550 people. As with the Johnson Space Center, only a portion of the facility's funding and staff are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Jornada Experimental Range (JER) is a unit of USDA's ARS located on the campus of New Mexico State University. Its Range Management Research Laboratory conducts research on rangeland management, with an emphasis on understanding basic ecological processes in desert environments. Specific re-

search activities of this unit include determining the effects of stressors on ecosystem processes, developing new knowledge to enhance survival and dispersal of native plants used for remediation of degraded rangeland, identifying chemical attributes of shrubs that contribute to their landscape dominance, and creating innovative methods that manipulate livestock foraging and associated behaviors. This federal R&D unit, in combination with USDA's nearby Southwestern Cotton Ginning Research Laboratory described below, annually receives approximately \$2.3 million of federal R&D funds and has about 23 FTEs.

- The New Mexico Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of New Mexico State University. It conducts research on avian ecology with emphasis on colonial waterbirds and neotropical migrants, large-scale ecological databases for geographic information system (GIS) application to landscape-level conservation planning in the southwest, and fish physiology with emphasis on impacts of environmental stressors. Specific research activities of this unit include studying habitat suitability for Aplomado falcons; fires management; species at risk; ecological context at Fort Bliss; developing biochemical, physiological, and organismal indices of contaminant effects in aquatic ecosystems (particularly mercury); and other national cooperative research and education programs addressing a variety of questions involving fish, other wildlife, and their habitats. This federal R&D unit annually receives approximately \$229,000 of federal R&D funds and has about two FTEs.

Los Alamos, New Mexico, is home to DOE's Los Alamos National Laboratory and DOI's Jemez Mountains Field Station.

- The Los Alamos National Laboratory is an FFRDC operated for DOE by the University of California. The laboratory's central research focus has been and continues to be on nuclear weapons to help ensure the viability of the nation's nuclear deterrent.

Other R&D activities include high-performance computing; arms control, verification, and safeguards; strategic defense; conventional defense technology; nuclear and nonnuclear energy technology; environmental science and technology; international economic development; basic defense and energy-related disciplines; and the human genome. This federally owned and contractor-operated laboratory annually receives approximately \$1.2 billion of core funding and conducts an estimated \$531 million of specific R&D projects. The laboratory has about 10,000 employees. A substantial portion of the laboratory's funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Jemez Mountains Field Station is a unit of the Mid-Continent Ecological Science Center inside DOI's USGS. It conducts research to develop and maintain ecological research and monitoring information needed to support management actions in the Jemez Mountains region, most especially Bandelier National Monument. Specific research activities of this unit include determining ecological conditions and restoration techniques in piñon-juniper woodlands, studying landscape-level fire histories and effects of fire across ecological gradients in the Jemez and Sangre de Cristo Mountains, and conducting environmental history research on the patterns and causes of ecological changes. This federal R&D unit annually receives approximately \$195,000 of federal R&D funds and has about two FTEs.

Mesilla Park, New Mexico, is home to USDA's Southwestern Cotton Ginning Research Laboratory.

- The Southwestern Cotton Ginning Research Laboratory is a unit of ARS's Jornada Experimental Range inside USDA. It conducts research to develop improved methods for ginning cotton in the irrigated west. The laboratory's research programs in saw and roller ginning cover all major stages of the ginning process, from seed-cotton conditioning and cleaning to ginning and lint

cleaning. Specific research activities of this lab include increasing lint production and its value, preserving the quality of the cotton fiber, and reducing or eliminating the air pollution associated with cotton ginning. The funding and staffing figures for this federal R&D unit are included in the Jornada Experimental Range description.

Socorro, New Mexico, is home to a portion of NSF's National Radio Astronomy Observatory.

- The National Radio Astronomy Observatory (NRAO) is an FFRDC sponsored by the National Science Foundation and operated by Associated Universities, Inc. It is headquartered in Charlottesville, Virginia, with observing sites in Green Bank, West Virginia; Tucson, Arizona; and Socorro, New Mexico. NRAO was established to ensure that all qualified scientists have access to radio astronomy facilities. NRAO's Very Large Array (VLA) and the Very Large Baseline Array (VLBA) are located west of Socorro, New Mexico. The VLA consists of 27 antennas arranged in a huge Y pattern that produce images of the radio sky at a wide range of frequencies and resolutions. The VLBA uses 10 parabolic antennas located across the continental United States and on Mauna Kea, Hawaii, and St. Croix in the U.S. Virgin Islands. Both VLA and VLBA are designed to produce images of celestial bodies. Both instruments provide valuable new capabilities to the scientific community. For example, VLA has been used to observe objects as near as the Moon and near-Earth asteroids, as far away as quasars at the edge of the observable universe, and nearly everything in between. Each year the four sites of this federally owned and consortium-operated unit collectively receive approximately \$44 million of federal R&D funds to conduct operations. The Socorro site alone annually receives approximately \$14 million of federal R&D funds and has about 200 employees. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Sunspot, New Mexico, is home to a portion of NSF's National Optical Astronomy Observatories.

- The National Optical Astronomy Observatories (NOAO) is an FFRDC sponsored by the NSF and operated by the Association of Universities for Research in Astronomy, Inc. Headquartered in Tucson, NOAO consists of an observatory on Kitt Peak, southwest of Tucson; an observatory north of Santiago, Chile, on the western slopes of the Andes; and a solar observatory co-located on Kitt Peak and Sunspot, New Mexico. Together, NOAO's observatories constitute the national center for ground-based optical and infrared astronomy and solar physics. The collective parts of this federal federally owned and consortium-operated unit annually receive approximately \$35 million of federal R&D funds and have about 300 employees. Only a small portion of these funds are spent in New Mexico.

White Sands, New Mexico, is home to DOD's White Sands Missile Range.

- White Sands Missile Range is a unit of DOD. It is a multiservice test range that supports the development of missiles for the Army, Navy, Air Force, NASA, other government agencies, and private industry. It works with all aspects of missiles, testing both developmental systems and production units to ensure continuing quality. The range is under the operational control of the U.S. Army Test and Evaluation Command at Aberdeen Proving Ground, Maryland. This federal facility annually receives about \$166 million of federal R&D funds for in-house R&D activities and has about 1,855 civilian personnel, most of whom are directly involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

FEDERAL R&D GRANTS TO NEW MEXICO ENTITIES

Every major institution of higher education in New Mexico is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, DOD, DOE, and NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of New Mexico (UNM), New Mexico State University (NMSU), New Mexico Highlands University (NMHU), and the New Mexico Institute of Mining and Technology (NM Tech). The table below shows the total number of R&D grants active in FY 1998, highlighting those made by HHS, DOD, DOE, and NSF to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category going to UNM and NMHU are from NASA, while those going to NMSU are from USDA.

Table 32.1 – Sources of Federal R&D Grants to Higher Education in New Mexico

	HHS		DOD		DOE		NSF		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
UNM	\$27M	115	\$9M	23	\$5M	21	\$5M	118	\$4M	31	\$51M	308
NMSU	\$2M	9	\$1M	10	\$1M	8	\$3M	44	\$5M	155	\$11M	226
NMHU	\$1M	1	\$1M	5	\$2M	2	<\$1M	2	\$1M	6	\$5M	16
NM Tech	<\$1M	1	<\$1M	4	<\$1M	6	\$1M	33	<\$1M	8	\$2M	52
Other	<\$1M	6	<\$1M	1	<\$1M	1	<\$1M	2	<\$1M	6	\$1M	16
Total	\$29M	132	\$11M	43	\$9M	38	\$9M	199	\$11M	206	\$70M	618

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a portion of the dollars available each year to various academic departments within these institutions. Included among these grants are ones from NASA, NSF, and DOD supporting the

Manuel Lujan, Jr., Space Tele-Engineering Program at NMSU, a telecommunications unit that conducts research in advanced communication systems and telemetering for deep space and the Space Station Freedom. Another grant from NASA supports the Earth Data Analysis Center (EDAC), previously known as the Technology Applications Center, at UNM. EDAC's mission is devoted entirely to researching, developing, and transferring remote sensing technology to observe Earth from space.

Several other nonacademic institutions in New Mexico also receive a significant amount of federal R&D grants each year. Foremost among these institutions that received R&D grants in FY 1998 are the Lovelace Respiratory Research Institute in Albuquerque (\$7 million), Los Alamos National Laboratory/University of California (\$6 million), the Santa Fe Institute of Science (\$2 million), the Coulston Foundation at Holloman Air Force Base (\$1 million), TPL, Inc., in Albuquerque (\$1 million), and New Mexico State Hospital in Las Vegas, New Mexico (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in New Mexico received 77 SBIR awards totaling \$17 million. Examples include a \$700,000 award from the Air Force to Science and Engineering Associates, Inc., in Albuquerque to develop a fieldable laser diode wound stabilization system and a \$600,000 award from NASA to Environmental Technology and Education in Albuquerque for work on a high-performance environmentally safe refrigerant.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting New Mexico are ones valued at more than \$1.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations,

forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in New Mexico every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NEW MEXICO

Several entities in New Mexico also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to Applied Research Associates, which in FY 1998 received close to \$34 million in DOD contracts for R&D work in such areas as fire technology research, environmental science, and weapons effect. In addition, Boeing Company (\$18 million), BDM International (\$11 million), Voss Scientific (\$10 million), Maxwell Technologies (\$8 million), and Kaman Sciences Corp. (\$6 million) received large R&D contracts from federal agencies in FY 1998. UNM (\$13 million) and NM Tech (\$4 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$16 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities in New Mexico. One of the largest of these cooperative agreements (\$2 million) came from DOE to the National Center for Genome Resources in Santa Fe for the establishment and operation of a genome database. Other federal agencies awarding cooperative agreements to New Mexico-based entities include NSF and DOC.

Chapter 33

Federal Research and Development in New York

- Approximately \$2.9 billion of federal R&D funds are spent each year in New York.
- New York ranks 8th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 7 percent of all federal funds received by New York for purposes other than the direct support of individuals (e.g. such entitlements as retirement, disability, and housing assistance, etc.) is spent on R&D.

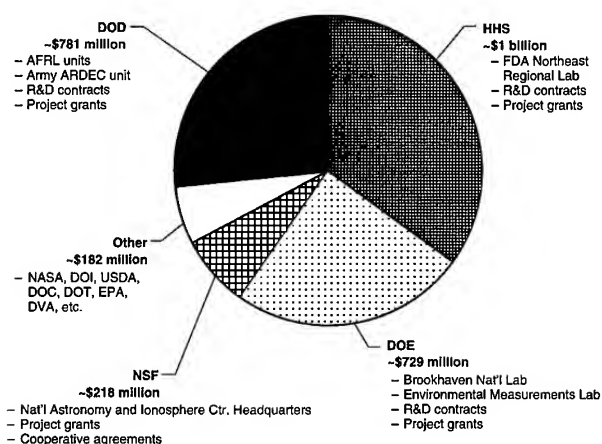


Figure 33.1 – Sources of Federal R&D Dollars Spent in New York
(Total Federal R&D ~\$2.9 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$2.9 billion annually in New York on research and development (R&D). On average, federal dollars for R&D account for approximately 7 percent of all federal funds received by New York for purposes other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in New York. Foremost among these agencies are the Departments of Health and Human Services (HHS), Defense (DOD), and Energy (DOE), which account for 35, 27, and 25 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF) accounts for an additional 7 percent of all federal R&D dollars spent in New York. The remaining federal R&D dollars come collectively from the National Aeronautics and Space Administration (NASA), the Departments of Agriculture (USDA), Commerce (DOC), Transportation (DOT), and Interior (DOI), and several other federal agencies.³³

All federal R&D dollars spent in New York either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in New York.

FEDERAL R&D UNITS IN NEW YORK

Bronx, New York, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Bronx VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 195 projects with

³³ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

total funding of approximately \$3.1 million. These R&D activities focus on a wide range of topics, including viral oncogenesis, AIDS, prosthetic devices for spinal cord injuries (SCI), metabolic alterations in SCI patients, Alzheimer's disease, psychiatry, renal disease, and disorders associated with alcoholism, tobacco, and digestion. This facility is also the site of a spinal cord tissue bank and a brain bank.

Brooklyn, New York, is home to HHS's Northeast Regional Laboratory.

- The Northeast Regional Laboratory is a unit of HHS's Food and Drug Administration. It conducts research on the safety and nutritiousness of food and the safety and efficacy of human drugs. Specific areas of research activity focus on drug and food chemistry, pesticides, and microbiology. This federal unit annually receives approximately \$894,000 of federal R&D dollars and has about 13 FTEs directly involved in R&D activities.

Cortland, New York, is home to DOI's Tunison Laboratory of Aquatic Sciences Field Station.

- The Tunison Laboratory of Aquatic Sciences Field Station is a unit of the Great Lakes Science Center inside DOI's U.S. Geological Survey (USGS). It conducts research on fish populations and communities, aquatic habitats, terrestrial ecology, nearshore and coastal communities, and the biological processes that occur in the complex ecosystem of the Great Lakes. Specific research activities of this unit include client-oriented integrated laboratory and field research to help foster sound management and stewardship of aquatic ecosystems and assist in restoring depleted species in the Northeast. This federal R&D unit annually receives approximately \$516,000 of federal R&D funds and has about eight FTEs.

Geneva, New York, is home to USDA's Plant Genetic Resources Unit.

- The Plant Genetic Resources Unit is part of USDA's Agricultural Research Service (ARS). This unit, which is on the Geneva

campus of Cornell University, is part of the national Plant Germplasm System. It was formed in 1986 by merging the Northeast Regional Plant Introduction Station and the newly created National Clonal Germplasm Repository for Apple and Grape. The research focus of this unit is on the conservation and utilization of apple, cold-hardy grape, tart cherry, and certain vegetable crops. The funding and staff figures for this federal R&D unit are included in those provided for the U.S. Plant, Soil, and Nutrition Laboratory described below.

Greenport, New York, is home to USDA's Plum Island Animal Disease Center.

- The Plum Island Animal Disease Center is a unit of USDA's ARS. It conducts research to protect U.S. animal industries and exports against catastrophic economic losses caused by foreign animal disease agents introduced either accidentally or deliberately into the United States. Specific research activities of the center include the development of more sensitive and accurate methods of disease agent detection and identification; the development of new strategies to control disease epidemics, including rDNA vaccines, antiviral drugs, and transgenic, disease-resistant animals; and the assessment of risks involved in importation of animals and animal products from countries where epidemic animal diseases occur. This federal R&D unit annually receives about \$9.3 million of federal R&D funds and has about 50 FTEs.

Ithaca, New York, is home to one of DOI's New York Cooperative Fish and Wildlife Research Units; USDA's Plant, Soil, and Nutrition Laboratory; and the headquarters of NSF's National Astronomy and Ionosphere Center.

- The New York Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Cornell University. It conducts research on aquatic resource problems and issues of the northeastern states, paying particular attention to these issues in New York. Specific research activities of this unit include

studying waterfowl biology and management, with a major emphasis on the productivity and harvest studies of Canada geese and mallard ducks in the Atlantic flyway. Other recent R&D activities emphasize the effects of human activities on aquatic systems, focusing on fish. This federal R&D unit annually receives approximately \$281,000 of federal R&D funds and has about three FTEs.

- The U.S. Plant, Soil, and Nutrition Laboratory is a unit of USDA's ARS located on the campus of Cornell University. It conducts research on the movement of essential or toxic elements through soil to plant roots, interactions at the root-soil interface, uptake by roots, translocation of elements to edible plant parts, and utilization of elements by humans or animals. Specific research activities include the development of plant varieties with higher concentrations of critical nutrients to create food-based solutions to malnutrition, improving root systems that can grow in nutrient-depleted soils, and utilizing plants to clean up polluted soils. This federal R&D unit annually receives approximately \$6.2 million in federal R&D funds and has about 44 employees.
- The National Astronomy and Ionosphere Center (NAIC) is a federally funded research and development center (FFRDC) sponsored by NSF, headquartered at Cornell University, and physically located in Puerto Rico. NAIC's Arecibo Observatory conducts research in astronomy and atmospheric sciences. It also develops new techniques and instruments for astronomical and atmospheric observations and data processing. The Arecibo Radio Telescope enables astronomers to detect the faint radio emissions from the universe. Experiments performed at the observatory help scientists measure the upper atmosphere composition, temperature, and densities. This federally owned and university-operated unit annually receives a total of approximately \$12 million of federal R&D funds, an estimated \$3 million of which are spent in New York.

New York, New York, is home to DOE's Environmental Measurement Laboratory, NASA's Goddard Institute for Space Studies, the Smithsonian Institution's National Museum of the American Indian and Cooper-Hewitt National Design Museum, and a DVA R&D unit.

- The Environmental Measurement Laboratory is a unit of DOE. It provides program management, technical assistance, and data quality assurance for measurements of radiation and radioactivity relating to environmental restoration, global nuclear non-proliferation, and other priority issues for DOE, as well as for other government, national, and international organizations. The activities of the laboratory include environmental sampling, aerosol measurements, radiological surveys, and radon assessments. This federal facility annually receives approximately \$6 million of federal R&D funds and has about 62 employees.
- The Goddard Institute for Space Studies is a unit of NASA's Goddard Space Flight Center in Greenbelt, Maryland. It focuses on the broad study of global change, an interdisciplinary research initiative addressing natural and man-made changes in our environment, which occur on various time scales from decades to millennia and which affect the habitability of Earth. The institute's research combines analyses of comprehensive global datasets of atmospheric, land surface, and oceanic processes and includes the study of past events on Earth, such as paleoclimate change and the study of other planets as an aid to prediction of future evolution of Earth on a planetary scale. This federal unit annually receives approximately \$9 million and has about 150 employees.
- The National Museum of the American Indian is a unit of the Smithsonian Institution. It conducts research on the life, arts, culture, and history of the native people of the Western Hemisphere. The museum annually receives approximately \$1.4 million of federal R&D funds and employs about 60 FTES, an estimated 10 percent of whom are involved in R&D activities.
- The Cooper-Hewitt National Design Museum is also a unit of the Smithsonian Institution. It conducts research on design

and decorative art objects, including drawings, prints, textiles, furniture, metalwork, ceramics, glass, woodwork, wall coverings, embroidery, and lace. The museum annually receives approximately \$120,000 of federal R&D funds and employs about 43 FTEs, only a fraction of whom are directly involved in R&D activities.

- While the principal focus of the New York VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 218 projects with total funding of approximately \$3 million. These R&D activities focus on a wide range of topics, including immunology, molecular biology, AIDS, infectious diseases, nephrology, and cell biology.

Oswego, New York, is home to DOI's Lake Ontario Biological Station.

- The Lake Ontario Biological Station is a unit of the Great Lakes Science Center inside DOI's USGS. It conducts research on fish populations and communities, aquatic habitats, terrestrial ecology, nearshore and coastal communities, and the biological processes that occur in the complex ecosystem of the Great Lakes. Specific research activities of this unit include assessing prey fishes to determine Lake Ontario's capacity to support stocked trout and salmon and evaluating restoration of naturally reproducing lake trout. This federal R&D unit annually receives approximately \$376,000 of federal R&D funds and has about five FTEs.

Rome, New York, is home to part of DOD's Air Force Research Laboratory Information Directorate and Air Force Research Laboratory Sensors Directorate.

- The Information Directorate is a unit of DOD's Air Force Research Laboratory. It is headquartered at the Rome Research Site, with another site in Dayton, Ohio. The R&D of this unit focuses on the advancement and application of information

system science for aerospace command and control and its transition to air, space, and ground systems. Its areas of investigation include a broad spectrum of information and fusion, communication, collaborative environment, modeling and simulation, defensive information warfare, and intelligent information systems technologies. This federal unit annually receives approximately \$101 million of federal R&D funds, only about 16 percent of which is spent on in-house R&D activities, and employs about 699 civilians, only a portion of whom are involved in R&D activities.

- The Sensors Directorate is a unit of DOD's Air Force Research Laboratory. It is headquartered in Dayton, Ohio, with other sites in Boston, Massachusetts, and Rome, New York. This unit works closely with industry, universities, and other DOD agencies to conduct R&D to ensure that U.S. air and space forces have the very best reconnaissance, surveillance, precision engagement, and electronic warfare capabilities. This federal unit annually receives approximately \$10 million of federal R&D funds, only about 28 percent of which is spent on in-house R&D activities, and has about 83 civilian personnel, only a portion of whom are involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Syracuse, New York, is home to USDA's Urban and Community Ecosystems Research Unit.

- The Urban and Community Ecosystem Research Unit Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on vegetation and associated resources in cities, suburbs, and developing areas. Specific research activities of this unit include developing planting models to help modify city climates and studying the effects of urban vegetation on air quality and atmospheric carbon dioxide. This federal R&D unit annually receives approximately \$750,000 of federal R&D funds and has about 12 employees.

Troy, New York, is home to DOI's New York District Office of Water Resources.

- The New York District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.9 million in federal R&D funds.

Upton, New York, is home to DOE's Brookhaven National Laboratory.

- The Brookhaven National Laboratory is an FFRDC sponsored by DOE and operated by Brookhaven Science Associates, a partnership between the State University of New York at Stony Brook and Battelle Memorial Institute. It houses the National Synchrotron Light Source and the Alternating Gradient Synchrotron particle accelerators. It also houses the Protein Data Bank, a digital repository containing thousands of detailed atomic structure maps of proteins and other biomacromolecules and the High-Flux Beam reactor, a reactor dedicated to research in the physical, chemical, biological, and environmental sciences. The laboratory has more than 600 R&D programs in fields ranging from high-energy physics to drug addiction to

weapons nonproliferation. This federally owned and contractor-operated laboratory annually receives approximately \$370 million of core funding and conducts an estimated \$286 million of specific R&D projects. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Watervliet, New York, is home to a unit of DOD's Armament Research, Development, and Engineering Center.

- The Benet Laboratories are a unit of the Army's Armament Research, Development, and Engineering Center inside DOD. The center is headquartered in Picatinny, New Jersey, with subordinate research activities in Rock Island, Illinois; Watervliet, New York; and Aberdeen, Maryland. It conducts research on integrating complex armament technologies into guns, ammunition, and fire control systems through research, development, acquisition, and sustainment. The laboratories conduct R&D on large-caliber armament systems, such as cannons, mortars, and recoilless rifles; tank gun mounts and recoil mechanisms; and tank turret components. This federal unit annually receives approximately \$1.3 million of federal R&D funds for in-house activities and has about 191 civilian personnel.

Albany, Bath, Brooklyn, Buffalo, Canandaigua, Northport, and Syracuse are also home to VA Medical Centers. While the principal focus of all of these federally owned and operated centers is providing medical care to veterans, each center is also the location of a number of research activities. In a recent year, these federally owned and operated facilities were the site of 1,529 projects with total funding of approximately \$4.9 million. These activities focus on a wide range of topics, including schizophrenia, AIDS, alcohol abuse, diabetes, and environmental hazards.

FEDERAL R&D GRANTS TO NEW YORK ENTITIES

Every major institution of higher education in New York is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Columbia University, Cornell University, State University of New York (SUNY), New York University (NYU), University of Rochester (Rochester), Albert Einstein College of Medicine (AECOM), Mount Sinai School of Medicine (MSSM), and Rockefeller University. The table below shows the total number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to Columbia are \$8 million from DOE, \$7 million from DOC, and \$4 million from NASA. Of the grants in this same category going to Cornell are \$13 million from USDA and \$4 million each from NASA and DOE. The grants going to SUNY in this category include \$9 million from DOE, \$5 million from the Department of Education,

Table 33.1 – Sources of Federal R&D Grants to Higher Education in New York

Institution	HHS		NSF		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Columbia	\$169M	619	\$29M	319	\$6M	37	\$21M	198	\$225M	1,173
Cornell	\$105M	447	\$25M	410	\$13M	73	\$22M	690	\$165M	1,620
SUNY	\$81M	443	\$28M	510	\$3M	22	\$21M	201	\$132M	1,176
NYU	\$88M	383	\$8M	151	\$4M	23	\$6M	30	\$105M	587
Rochester	\$82M	392	\$8M	122	\$6M	29	\$8M	31	\$104M	574
AECOM	\$99M	311	\$1M	12	<\$1M	2	<\$1M	1	\$100M	326
MSSM	\$80M	331	<\$1M	10	\$3M	6	\$3M	11	\$86M	358
Rockefeller	\$44M	174	<\$1M	20	<\$1M	2	\$1M	3	\$45M	199
Other	\$53M	290	\$25M	457	\$9M	88	\$12M	202	\$99M	1,037
Total	\$800M	3,390	\$125M	2,011	\$44M	282	\$93M	1,367	\$1,062M	7,050

and \$3 million each from DOC and NASA. NYU's grants in the "Other Agencies" category are split between DOE and the Environmental Protection Agency (EPA).

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the School of Arts and Sciences at Columbia University.

Several other nonacademic institutions in New York also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Memorial Sloan-Kettering Cancer Center in New York City (\$57 million), the Research Foundation for Mental Hygiene (\$48 million) in New York City, Health Research, Inc. (\$35 million), in Albany and Buffalo, Cold Spring Harbor Laboratory (\$23 million), and the National Development and Research Institutes (\$13 million) in New York City.

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in New York received 167 SBIR awards totaling \$38 million. Examples include a \$750,000 award from the Air Force to Laser Photonics Technology, Inc., in Amherst for work on high-capacity holographic data storage and a \$500,000 award from the Department of Transportation to Innovative Dynamics in Ithaca for work on remote sensors for pavement ice detection.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting New York are ones valued at more than \$5.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry

schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in New York every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NEW YORK

Several entities in New York also receive notable sums from federal agencies in the form of contracts and cooperative agreements for specific R&D efforts. By far, the majority of these funds go to the New York-based divisions of Northrop Grumman and Lockheed Martin, which in FY 1998 received close to \$308 million and \$72 million, respectively, in contracts from DOD for R&D work on such programs as the Joint Surveillance and Target Attack Radar System (JSTARS), E-2C aircraft, LAMPS helicopters, and Lightweight Broadband Variable Depth Sonar (LBVDS). In addition, Calspan Corporation, LNY Sales, ITT Industries, and General Electric each received between \$8 million and \$22 million of R&D contracts from federal agencies in FY 1998. The University of Rochester, Cornell University, Columbia University, NYU, and Yeshiva University (home of AECOM) also received contracts from various federal agencies to conduct R&D for the federal government that collectively totaled \$28 million in FY 1998. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$106 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities located in New York. By far the largest of these cooperative agreements (\$25 million) went from DOE to the University of Rochester for the management and operation of the National Laser User's Facility (NLUF). This facility is the heart of the Laboratory for Laser Energetics (LLE) operated by the University of Rochester for DOE's Office of Inertial Fusion. LLE was established in 1970 to support investigations of the interaction of intense radiation with matter and to house experiments in plasma physics, x-ray laser physics, spectroscopy, and instrumentation development. Other federal agencies awarding cooperative agree-

ments to New York-based entities include NSF, DOC, and DOD. Among these latter cooperative agreements are awards supporting two of NSF's Science and Technology Centers—the Center for High-Pressure Research, at SUNY-Stony Brook, and the Center for Photo-induced Charge Transfer at the University of Rochester. In addition, New York is home to four of NSF's Materials Research Science and Engineering Centers—the Center for Novel Materials by Thermal Spray Research at SUNY-Stony Brook, the Materials Science Center at Cornell University, the Mixed Organic/Inorganic Materials Center at Columbia University, and the Center for Polymers at Engineered Interfaces at SUNY-Stony Brook. Not included among these cooperative agreements is one for \$12 million awarded by NSF to Cornell University for the operation of the National Astronomy and Ionosphere Center, an FFRDC located in Arecibo, Puerto Rico. This FFRDC is detailed in the section on “Federal R&D Units in Puerto Rico.”

Chapter 34

Federal Research and Development in North Carolina

- Approximately \$923 million of federal R&D funds are spent each year in North Carolina.
- North Carolina ranks 19th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 7 percent of all federal funds spent in North Carolina each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

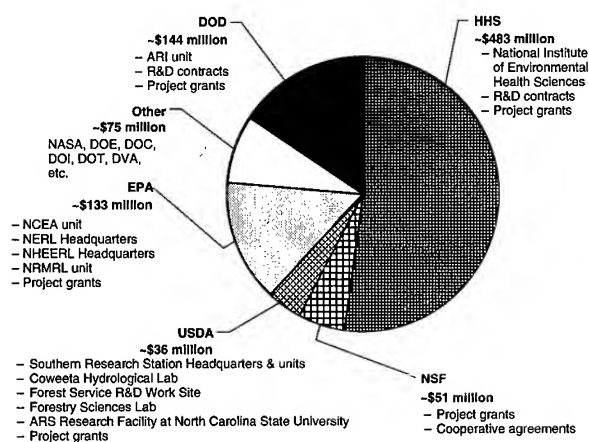


Figure 34.1 – Sources of Federal R&D Dollars Spent in North Carolina
(Total Federal R&D ~\$923 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$923 million annually in North Carolina on research and development (R&D) activities. On average, federal R&D dollars account for approximately 7 percent of all federal funds spent in North Carolina each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in North Carolina. Foremost among these agencies is the Department of Health and Human Services (HHS), which accounts for 52 percent of all federal R&D dollars spent in North Carolina each year. The Department of Defense (DOD), the Environmental Protection Agency (EPA), the National Science Foundation (NSF), and the Department of Agriculture (USDA) account for an additional 16, 14, 6, and 4 percent of all federal R&D dollars spent in North Carolina, respectively. The remainder of federal R&D dollars come from the Department of Commerce (DOC), the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and several other agencies.³⁴

All federal R&D dollars spent in North Carolina either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in North Carolina.

FEDERAL R&D UNITS IN NORTH CAROLINA

Asheville, North Carolina, is home to USDA's Forest Service's Southern Research Station Headquarters.

- The Station Headquarters of the Southern Research Station (SRS) is a unit inside USDA's Forest Service that oversees re-

³⁴ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

search sites and experimental forests in 13 southern states. The Southern Forest Inventory, Monitoring, and Analysis Program is the SRS research site located at SRS headquarters. It conducts research to develop, analyze, and maintain forest resources information for southern states and conducts research to provide improved inventory and evaluation techniques. Specific research activities of this program include detailed databases from inventories, which are used extensively by forest industry, state agencies, consultants, and National Forests. While all portions of SRS annually receive around \$34 million of federal R&D funds, the Station Headquarters annually receives approximately \$4.3 million of these funds and has about 96 employees.

Beaufort, North Carolina, is home to the DOC's Beaufort/Oxford Laboratory.

- The Beaufort/Oxford Laboratory is a unit of the Southeast Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts research on the biological productivity of estuaries and nearshore and ocean ecosystems, the dynamics of coastal and reef fishery resources, and the effects of man on resource productivity. The laboratory also manages NOAA's Coastal Change Analysis Project and the South Atlantic Bight Recruitment Experiment. This federal unit annually receives approximately \$4.1 million of federal R&D funds and has about 75 FTEs, only a portion of whom are involved in R&D activities. A small portion of the laboratory's activities take place in Oxford, Maryland.

Durham, North Carolina, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Durham VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 324 projects with total funding of approximately \$7 million. These R&D activities focus on a wide range of topics, including mental health, gerontology, cardiovascular diseases, and infectious diseases.

Fort Bragg, North Carolina, is home to DOD's Fort Bragg Scientific Research Office.

- The Fort Bragg Scientific Research Office is a unit inside DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are located in Fort Rucker, Alabama; Fort Benning, Georgia; Fort Knox, Kentucky; Fort Leavenworth, Kansas; Orlando, Florida; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. The unit conducts research on personnel training issues in support of Army Special Operations Command. Specific research activities of this unit include the selection and assessment of Special Operations Forces. In addition, research programs and technical advisory services are directed to special interest issues related to personnel selection and training. This federal unit annually receives approximately \$148,000 in federal R&D funds and has one civilian employee directly involved in R&D activities.

Otto, North Carolina, is home to the USDA's Coweeta Hydrological Laboratory.

- The Coweeta Hydrologic Laboratory is a unit of the Southern Research Station inside USDA's Forest Service. It conducts research on watershed responses to the atmospheric environment and natural disturbances, forest management treatments (such as clearcutting, farming, logging, road building, insect infestations, chemical exposure, fire, and airborne nutrients and pollutants), and other human disturbances. Specific research activities of this lab include evaluating, explaining, and predicting how water, soil, and forest resources respond to such disturbances as well as identifying practices that mitigate such impacts. The laboratory is also a participant in international research programs and NSF's Long-Term Ecological Research site, which conducts research on ecological phenomena that occur on time scales of decades or centuries. This federal R&D unit annually receives approximately \$970,000 of federal R&D funds and has about 13 employees.

Raleigh, North Carolina, is home to a USDA Forest Service R&D Work Site and Agricultural Research Service (ARS) Research Facility at North Carolina State University and the Department of Interior's (DOI's) North Carolina Cooperative Fish and Wildlife Research Unit and North Carolina District Office of Water Resources.

- The R&D Work Site is a unit of the Southern Research Station inside USDA's Forest Service located on the campus of North Carolina State University. It conducts research on forest ecosystem response to global change, including air pollution, current and potential future climate stress, and changing human resource demands. Specific research activities of this program include developing and evaluating science-based strategies to ensure sustained productivity and ecosystem health. Current research include the analysis of existing databases and collection of new regional databases; the establishment of research to increase scientific understanding of ecosystem processes; and the development of new, and use of existing, forest models to link research, monitoring, and forest inventories across time and space. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about four employees.
- The ARS Research Facility at North Carolina State University is a unit of USDA's ARS. It consists of six research divisions focusing on air quality, plant growth, and development; food science; market quality and handling; plant science; and soybean and nitrogen fixation. Some of these divisions conduct research on the effects of the changing atmospheric environment on crop production and plant health to develop techniques for mitigating the problems and methods for the preservation of vegetables by fermentation or direct acidification that will result in improved processing efficiency. Other divisions conduct research to enhance the flavor and shelf-life of domestic and export peanuts and peanut products and to discover the genetic basis of yield and resistance to disease and environmental stresses in corn and small grains. Yet another division conducts research to im-

prove product quality, economic worth, nutritional value and reduced production costs or losses from soybeans. This federal R&D unit annually receives about \$5.8 million of federal R&D funds and has about 57 FTEs.

- The North Carolina Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the campus of North Carolina State University. It conducts research on the identification, assessment, interpretation, and alleviation of the effects of current or potential environmental changes or perturbations on fish and wildlife resources, with an emphasis on how the entire ecosystem is affected. Specific research activities of this unit include a GIS-based study of land use and terrestrial vertebrate distribution using NC GAP analysis, migration and spawning habitat requirements of anadromous fishes, natural mortality rates of reservoir striped bass, and factors affecting reproduction and migration of waterbirds. This federal R&D unit annually receives approximately \$319,000 of federal R&D funds and has about four FTEs.
- The North Carolina District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater

quality. This federal unit annually receives approximately \$1.6 million in federal R&D funds.

Research Triangle Park, North Carolina, is home to HHS's National Institute of Environmental Health Sciences, parts of the EPA's National Center for Environmental Assessment, National Exposure Research Laboratory, National Health and Environmental Effects Research Laboratory, and Air Pollution Prevention and Control Division, and USDA's Research Triangle Park Forestry Sciences Laboratory.

- The National Institute of Environmental Health Sciences is a unit of HHS's National Institutes of Health (NIH), which is headquartered in Bethesda, Maryland. It conducts biomedical research on the interrelationships of the three elements of human disease—environmental factors, individual susceptibility, and age. Specific research activities of the institute include studying the effects of asbestos exposure, the developmental impairment of children exposed to lead, human fertility, birth defects and developmental defects, hazards specific to the poor, agricultural pollution, toxins that may play a role in Alzheimer's disease and other neurologic disorders, and the health effects of urban pollution. The institute has played a key role in identifying the first breast cancer gene, BRCA1, and a gene that suppresses prostate cancer. It has also developed genetically altered mice to improve the screening of potential toxins and to help develop aspirin-like anti-inflammatory drugs with fewer side effects. This federal unit annually receives approximately \$84.9 million of federal R&D funds and has about 677 employees.
- EPA's National Center for Environmental Assessment, which is headquartered in Washington, D.C., maintains an office in Research Triangle Park, North Carolina. This office conducts research on major air pollutants, health and ecological assessments of air toxics, and fuel and fuels additives. Current research focuses on dose-response models and factors, exposure models and factors, probabilistic models, and community-based risk assessment. This federal R&D unit annually receives about \$4.6 million of federal R&D funds and has about 33 FTEs.

- The National Exposure Research Laboratory is a unit of the EPA. While it is headquartered in Research Triangle Park, North Carolina, the laboratory has divisions in Cincinnati, Ohio; Athens, Georgia; and Las Vegas, Nevada, as well as Research Triangle Park. The laboratory provides scientific understanding, information, and assessment tools to reduce and quantify the uncertainty in the agency's exposure and risk assessments for all environmental stressors. Stressors include chemicals, biologicals, radiation, and changes in climate and land and water use. The Atmospheric Sciences Modeling Division in Research Triangle Park conducts research on stressor sources; pollutant transport, transformations, and exposure; and source-to-receptor predictive exposure models applicable to the appropriate temporal scales and to site, watershed/regional, and global scales. It also conducts receptor and stressor analyses and evaluations of alternative mitigation, management, or restoration strategies from an exposure perspective. Together the headquarters and division annually receive about \$61 million of federal R&D funds and have about 204 FTEs.
- The National Health and Environmental Effects Research Laboratory is a unit of the EPA. While it is headquartered in Research Triangle Park, it has divisions in Narragansett, Rhode Island; Gulf Breeze, Florida; Duluth, Minnesota; and Corvallis, Oregon, as well as four divisions and one program in Research Triangle Park. The Human Studies Division conducts clinical and epidemiological investigations to improve the understanding of human health risks associated with environmental pollution. It focuses on improving assessments of exposure, biologically relevant doses, and adverse biological or health effects, as well as investigating mechanisms linking these phenomena. The Experimental Toxicology Division conducts research on the health effects of inhaled, ingested, and dermally contacted environmental pollutants. The Neurotoxicology Division studies the effects of physical and/or chemical agents on the nervous system. It focuses on providing the scientific basis and technolog-

ical means to predict whether or not environmental agents will produce neurotoxicity in humans. The Reproductive Toxicology Division conducts biological research on the effects of environmental pollutants, singly or in combination, on all stages of the life cycle. The research seeks to assess the potential hazards to humans resulting from exposure to various environmental pollutants. The chemical agents under investigation include toxic substances, pesticides, air pollutants, drinking water contaminants, and hazardous wastes. The Environmental Monitoring and Assessment Program develops the tools to monitor and assess the status and trends of national ecological resources. It conducts research to advance the science of ecological monitoring and ecological risk assessment and to guide national monitoring of ecosystem integrity and dynamics. Together the headquarters unit and the five divisions/programs annually receive about \$66.8 million of federal R&D funds and have about 367 FTEs.

- The Air Pollution Prevention and Control Division is a unit of the EPA's National Risk Management Research Lab headquartered at Research Triangle, North Carolina. It conducts R&D on air pollution prevention and control technologies for manufacturing and processing industries, power plants, incinerators, indoor environments, and sources of greenhouse gases. Research includes the characterization and assessment of all sources of air pollution and verification of the performance of innovative technologies. It participates in the Environmental Technology Verification program to verify the performance of innovative technical solutions to problems that threaten human health or the environment. This federal R&D unit annually receives about \$14 million of federal R&D funds and has about 87 FTEs.
- The Research Triangle Park Forestry Sciences Laboratory is a unit of the Southern Research Station inside USDA's Forest Service. It conducts research on aboveground and belowground processes governing forest productivity and sustainability; for-

est health to detect unexpected deviation from established baseline conditions or trends, identify causes, and define basic relationships sufficient to predict consequences; and economic status, trends, and opportunities for forest management in the southern United States. Specific research activities include studying the effects of silvicultural practices and soil/atmospheric properties on forest growth and productivity to develop sustainable management systems for southern forest resources. Other activities include analyzing the economic effect of public programs and regulations on private forest landowners; performing economic and impact assessments of forest insect, disease, and other forest health questions; and developing and implementing regional forest resource analysis models of inventory, multiple-use, and land area interactions. This federal R&D unit annually receives approximately \$4.3 million of federal R&D funds and has about 29 employees.

Salisbury, North Carolina, is home to a DVA R&D unit.

- While the principal focus of the Salisbury–W. G. (Bill) Hefner VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of two projects with total funding of less than \$50,000. These R&D activities focus on such topics as blindness and diabetes.

FEDERAL R&D GRANTS TO NORTH CAROLINA ENTITIES

Every major institution of higher education in North Carolina is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, DOD, and NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of North Carolina (U of NC), Duke University, Wake Forest University, North Carolina State University (NC State), North Carolina Agricultural and Technical State University (NCA&T), and East Carolina

University (ECU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, DOD, and NSF to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of North Carolina are ones from EPA (\$9 million), DOC (\$3 million), and DOE (\$2 million). The comparable grants going to Duke include \$6 million from DOE and \$1 million each from NASA, EPA, and the Department of Education. The grants in this same category going to NC State come from USDA (\$9 million) and DOE, DOC, NASA, and EPA (\$2 million each). Those going to NCA&T come mainly from USDA (\$3 million) and NASA (\$1 million).

Table 34.1 – Sources of Federal R&D Grants to Higher Education in North Carolina

Institution	HHS		DOD		NSF		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of NC	\$151M	684	\$11M	49	\$12M	213	\$15M	91	\$189M	1,037
Duke	\$158M	636	\$16M	55	\$14M	178	\$10M	82	\$198M	951
Wake Forest	\$56M	208	\$1M	5	\$1M	31	<\$1M	2	\$58M	246
NC State	\$8M	63	\$11M	69	\$10M	194	\$19M	522	\$48M	848
NCA&T	<\$1M	3	\$1M	8	\$1M	8	\$4M	70	\$7M	89
ECU	\$3M	26	\$1M	2	<\$1M	10	<\$1M	2	\$4M	40
Other	\$6M	69	\$1M	8	\$1M	19	\$2M	40	\$9M	136
Total	\$383M	1,689	\$41M	196	\$39M	653	\$49M	809	\$512M	3,347

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the School of Medicine at Duke University.

Several other nonacademic institutions in North Carolina also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Re-

search Triangle Institute in Durham (\$36 million), the International Fertility Research Program in Durham (\$15 million), and Technology Planning & Management Corp. in Durham (\$3 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in North Carolina received 57 SBIR awards totaling \$14 million. Examples include a \$750,000 award from HHS to Andcare, Inc., in Durham for work on DNA probes for detection of gene disorders and a \$750,000 award from DOE to Geophex, Ltd., in Raleigh to study passive and active low-frequency electromagnetic spectroscopy for airborne detection of underground facilities.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting North Carolina are ones valued at more than \$9 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in North Carolina every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NORTH CAROLINA

Several entities in North Carolina also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of the funds go to Research Triangle Institute, which in FY 1998 received close to \$48 million in R&D contracts for work on such efforts as assisting NASA laboratories in the development of nonaerospace uses for its technology, and

chemistry support for NIH/NIEHS National Toxicology Program environmental studies. In addition, Family Health International (\$23 million), NSI Technology Services Corp. (\$10 million), Digital Optics Corp. (\$9 million), and MCNC (\$7 million) received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Research Triangle Institute. The University of North Carolina (\$39 million), Duke University (\$20 million), NC State University (\$3 million), and Wake Forest University (\$3 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$16 million of federal R&D dollars was also received in FY 1998 by entities located in North Carolina in the form of cooperative agreements. By far the largest of these cooperative agreements (\$5 million in FY 1998) came from the DOC Advanced Technology Program to IBM and the CIIMPLEX consortium to develop systems for the management of supply-chain enterprise coalitions. Other federal agencies awarding cooperative agreements to North Carolina-based entities include USDA and DOD.

Chapter 35

Federal Research and Development in North Dakota

- Approximately \$58 million of federal R&D funds are spent each year in North Dakota.
- North Dakota ranks 49th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 3 percent of all federal funds spent in North Dakota each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

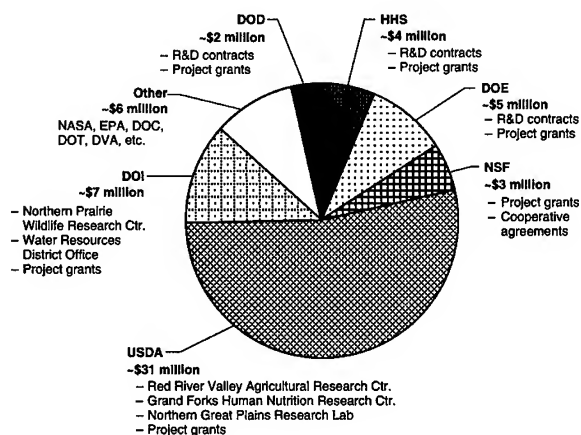


Figure 35.1 – Sources of Federal R&D Dollars Spent in North Dakota
(Total Federal R&D ~\$58 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$58 million annually in North Dakota on research and development (R&D) activities. On average, federal R&D dollars account for approximately 3 percent of all federal funds spent in North Dakota each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in North Dakota. Foremost among these agencies is the Department of Agriculture (USDA), which accounts for 53 percent of all federal R&D dollars spent in the state. The Departments of Interior (DOI), Energy (DOE), and Health and Human Services (HHS), and the National Science Foundation (NSF) account for an additional 12, 9, 6, and 6 percent of all federal R&D dollars spent in North Dakota, respectively. The remaining federal R&D dollars come collectively the Department of Transportation (DOT), the Environmental Protection Agency (EPA), and several other federal agencies.³⁵

All federal R&D dollars spent in North Dakota either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in North Dakota.

FEDERAL R&D UNITS IN NORTH DAKOTA

Bismarck, North Dakota, is home to DOI's North Dakota District Office of Water Resources.

- The North Dakota District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Sub-

³⁵ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

stances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$855,000 in federal R&D funds.

Fargo, North Dakota, is home to USDA's Red River Valley Agricultural Research Center, and a Department of Veterans Affairs (DVA) R&D unit.

- The Red River Valley Agricultural Research Center is a unit of USDA's Agricultural Research Service (ARS) located on the campus of North Dakota State University. It consists of the Biosciences Research Laboratory, the Northern Crop Science Laboratory, and the Hard Spring and Durum Wheat Quality Laboratory. The activities of the Biosciences Research Laboratory focus on animal metabolism and agricultural chemicals, plant science, and insect genetics and biochemistry. Specific research activities of this laboratory include reducing the impact of foreign chemicals on food-producing animals and food as it is being processed, the biology of weed plants to reduce crop losses, and controlling and managing pest and beneficial insects. The Northern Crop Science Laboratory conducts research on developing breeding lines of sunflowers to resist diseases and insects, identifying sugarbeet genotypes that exhibit hybrid vigor and increased production efficiency, and identifying and characterizing biochemical mechanisms of resistance in

sugarbeet against *Rhizoctonia solani* and *Cercospora beticola*. Specific research activities of the Hard Spring and Durum Wheat Quality Laboratory include investigating the genetics of disease resistance, lodging resistance, and other agronomic traits and developing germplasm and genetic stocks useful in genetic analyses and in breeding of improved varieties. These federal R&D units combined receive approximately \$9.8 million of federal R&D funds and have about 110 FTEs.

- While the principal focus of the Fargo VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 48 projects with total funding of less than \$25,000. These R&D activities focus on a wide range of topics, including cerebrovascular disorders, anti-neoplastic agents, unstable angina, and microbial drug resistance.

Grand Forks, North Dakota, is home to USDA's Grand Forks Human Nutrition Research Center.

- The Grand Forks Human Nutrition Research Center is a unit of USDA's ARS located on the campus of the University of North Dakota. It is composed of the Mineral Nutrient Requirement Laboratory and the Mineral Nutrient Functions Laboratory. The center conducts research to determine the roles of nutrients, with an emphasis on mineral elements, in regulating physiological and psychological function and performance in the presence of a variety of nutritional, environmental, and psychological stressors. Specific research activities of this unit include a magnesium study to establish the importance of magnesium in the adult diet and a weight loss study to examine how copper and magnesium interact while a person is losing weight. This federal R&D unit annually receives approximately \$7.7 million of federal R&D funds and has about 60 FTEs.

Jamestown, North Dakota, is home to DOI's Northern Prairie Wildlife Research Center.

- The Northern Prairie Wildlife Research Center is a unit of DOI's USGS. It conducts research on the quantitative ecologi-

cal requirements for sustainable wildlife populations. Specific research activities of this center include designing and conducting studies of numbers and distribution of flora and fauna, including identification of change resulting from habitat loss and modification. Recent research includes a study on the influence of agriculture on aquatic invertebrate communities of temporary wetlands in the prairie pothole region of North Dakota. This federal R&D unit annually receives approximately \$1.6 million of federal R&D funds and has about 51 FTEs.

Mandan, North Dakota, is home to a unit of USDA's Northern Great Plains Research Laboratory.

- The Northern Great Plains Research Laboratory is a unit of the USDA's ARS located on the Mandan campus of North Dakota State University. It is composed of the Natural Resource Research Management Unit. The unit conducts research to develop integrated crop and livestock management systems for conservation and efficient use of natural resources. Specific research activities of this unit include investigating plant-soil-water-animal interactions; developing soil, water, crop/forage, and nutrient management strategies; and developing improved tree and forage cultivars/germplasm. This R&D unit receives approximately \$2.6 million of federal R&D funds and has about 34 FTEs.

FEDERAL R&D GRANTS TO NORTH DAKOTA ENTITIES

Every major institution of higher education in North Dakota is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by USDA, HHS, NSF, and NASA to individual faculty members and therefore ultimately inure to the benefit of such institutions as North Dakota State University (NDSU) and the University of North Dakota (UND). The table below shows the number of R&D grants active in FY 1998, highlighting those made by USDA, HHS, NSF, and NASA to parties at these institutions and estimates of the total dollars transferred to them

in FY 1998 pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category going to NDSU are from DOD and the Department of Transportation. The comparable grants going to UND are primarily from EPA.

Table 35.1 – Sources of Federal R&D Grants to Higher Education in North Dakota

	USDA		HHS		NSF		NASA		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
NDSU	\$3M	20	\$1M	9	\$1M	21	<\$1M	3	\$2M	153	\$7M	206
UND	\$1M	4	\$1M	16	\$1M	10	\$2M	10	\$1M	11	\$6M	51
Other	<\$1M	1	0	0	<\$1M	1	<\$1M	2	<\$1M	2	<\$1M	6
Total	\$5M	25	\$2M	25	\$2M	32	\$2M	15	\$3M	166	\$14M	263

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in North Dakota also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Blue Cross/Blue Shield of North Dakota in Fargo (\$1 million) and St. Luke's Hospitals in Fargo (\$500,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in North Dakota received four SBIR awards totaling close to \$300,000. Examples include a \$100,000 award from DOD (Air Force) to Dakota Technologies in Fargo to develop a real-time fuel leak detector and a \$60,000 award from USDA to Harvest Fuels, Inc., in Walhalla for work on the bioprocessing of wheat midds and screenings to improve protein.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting North Dakota are ones valued at more than \$2.2 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in North Dakota every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN NORTH DAKOTA

Several entities in North Dakota also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. A large portion of these funds go from DOD to Wheeler Contracting, Inc., which in FY 1998 received close to \$500,000 in support of Army Strategic Defense Command activities. In addition, Uniband, Inc. (\$300,000), and Dakota Technologies (\$200,000) received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Dakota Technologies (\$75,000). UND (\$500,000) and NDSU (\$150,000) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$7 million of federal R&D dollars was also received in FY 1998 by entities in North Dakota in the form of cooperative agreements. The largest of these cooperative agreements (\$2 million in FY 1998) came from DOE to the Energy and Environmental Research Center at UND for work on the Gas Industry Groundwater Research Program. Other federal agencies awarding cooperative agreements to North Dakota-based entities include NSF and USDA.

Chapter 36

Federal Research and Development in Ohio

- Approximately \$2.7 billion of federal R&D funds are spent each year in Ohio.
- Ohio ranks 9th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 15 percent of all federal funds spent in Ohio each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

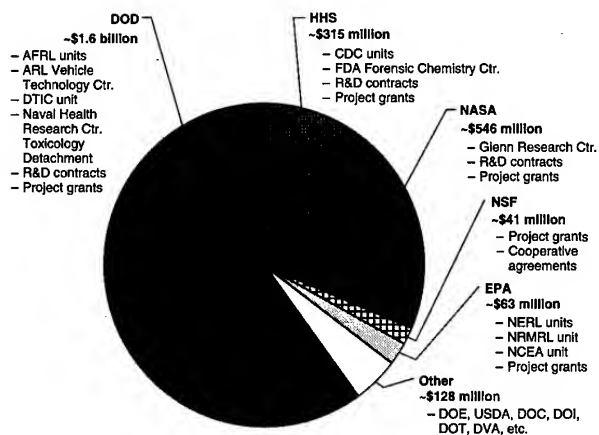


Figure 36.1 – Sources of Federal R&D Dollars Spent in Ohio
(Total Federal R&D ~\$2.7 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$2.7 billion annually in Ohio on research and development (R&D) activities. On average, federal R&D dollars account for approximately 15 percent of all federal funds spent in Ohio each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Ohio. Foremost among these agencies is the Department of Defense (DOD), which accounts for 60 percent of all federal R&D dollars spent in the state. The National Aeronautics and Space Administration (NASA) and the Department of Health and Human Services (HHS) account for an additional 20 and 11 percent, respectively, of all federal R&D dollars spent in Ohio. The remaining federal R&D dollars come collectively from the Environmental Protection Agency (EPA), the National Science Foundation (NSF), the Department of Energy (DOE), and several other federal agencies.³⁶

All federal R&D dollars spent in Ohio either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Ohio.

FEDERAL R&D UNITS IN OHIO

Cincinnati, Ohio, is home to HHS's Divisions of Biomedical and Behavioral Sciences, Physical Sciences and Engineering, Education and Information, Surveillance, Hazards Evaluations, and Field Studies, and its Forensic Chemistry Center; part of the EPA's National Risk Management Research Laboratory, its Ecological Exposure Research Division and Microbiological and Chemical Exposure Assessment Re-

³⁶ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

search Division, and part of its National Center for Environmental Assessment; and a Department of Veterans Affairs (DVA) R&D unit.

- The Biomedical and Behavioral Sciences Division; the Division of Physical Sciences and Engineering; the Education and Information Division; and the Division of Surveillance, Hazards Evaluations, and Field Studies are units of the National Institute of Occupational Safety and Health (NIOSH) inside HHS's CDC. They conduct research on toxicological issues, psychological stress, physical agents, and ergonomics as these issues relate to worker safety and health. Specific research activities of these units include conducting control-technology assessments and research programs to prevent occupational disease and injury before they occur by assisting employers in improving the design and operation of the workplace. The units also provide criteria and standards on monitoring strategies, instrumentation, and controls and conduct research to improve methods for analyzing toxic substances found in the workplace. These federal units in combination annually receive approximately \$36.1 million of federal R&D funds and have about 436 FTEs.
- The Forensic Chemistry Center is a unit of HHS's Food and Drug Administration. It conducts R&D on foods, human drugs, animal drugs and devices, and the effects of radiological devices on health. A special area of research activity is elemental analysis of substances. This federal unit annually receives approximately \$2.8 million of federal R&D funds and has about 32 FTEs directly involved in R&D activities.
- The National Risk Management Research Laboratory is a unit of the EPA. It conducts R&D to prevent, control, or remediate environmental problems that threaten human health and the environment. While the laboratory is headquartered in Cincinnati, it has divisions in Research Triangle Park, North Carolina; and Ada, Oklahoma; as well as in Cincinnati. The Land Remediation and Pollution Control Division conducts research to solve land pollution problems. The Sustainable Technology Division conducts R&D to prevent, remove, and control environmental

risks to human health and ecology. The Water Supply and Water Resources Division conducts research on the control of waterborne contaminants, with an emphasis on drinking water and its regulation. The fourth division coordinates the R&D programs and administers the technology transfer program. These four divisions of this laboratory annually receive approximately \$72 million of federal R&D dollars and have about 247 FTEs. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Ecological Exposure Research Division and the Microbiological and Chemical Exposure Assessment Research Division are units of EPA's National Exposure Research Laboratory headquartered in Research Triangle Park, North Carolina. The first division conducts R&D on molecular biological and biochemical indicators of the environment, environmental stressors, and chemical indicators for measuring contaminant levels and exposure of biota inhabiting stream ecosystem. It also evaluates the performance of laboratories supporting the water programs administered by both the EPA and the states pursuant to the provisions of the Clean Water Act. The second division conducts research on measuring, characterizing, and predicting the exposure of humans to chemical and microbial hazards. Together, these two divisions annually receive approximately \$13.6 million of federal R&D funds and have about 95 FTEs.
- EPA's National Center for Environmental Assessment, which is headquartered in Washington, D.C., maintains an office in Cincinnati. This office provides information and analysis on methods R&D. Specifically, this office conducts environmental risk assessment research and engages in problem identification, hypothesis generation, method development, method evaluation, method validation, and method application. This office annually receives approximately \$5.5 million of federal R&D funds and has about 34 FTEs.
- While the principal focus of the Cincinnati VA Medical Center is providing medical care to veterans, it is also the location of a

number of research activities. In a recent year, this federally owned and operated facility was the site of 273 projects with total funding of approximately \$2 million. These R&D activities focus on a wide range of topics, including psychiatric status rating scales, schizophrenia, substance dependence, and neoplasms.

Cleveland, Ohio, is home to a unit of DOD's Army Research Laboratory, NASA's Glenn Research Center, and a DVA R&D unit.

- The Vehicle Technology Directorate is a unit of DOD's Army Research Laboratory. The laboratory is headquartered in Adelphi, Maryland, with additional sites in Aberdeen, Maryland; White Sands, New Mexico; Hampton, Virginia; Eatontown, New Jersey; and Atlanta, Georgia. A portion of this directorate conducts propulsion research at NASA's Glenn Research Center in Cleveland, as well as at NASA's Langley Research Center in Virginia. A closely related unit can be found at the Langley Research Center in Virginia. The directorate conducts R&D on gas turbine engines and advanced power transmission systems for air and ground vehicle systems. Recent R&D activities have included participation in the Integrated High-Performance Turbine Engine Technology Program and the Joint Turbine Advanced Gas Generator Demonstration. This federal unit annually receives approximately \$6.3 million of federal R&D funds, about \$4.5 million of which are spent on in-house activities, and has about 54 civilian personnel.
- The Glenn Research Center, formerly the Lewis Research Center, is a unit of NASA. It conducts R&D on aeropropulsion and turbomachinery. Specifically, the center develops air-breathing propulsion technology for subsonic, supersonic, hypersonic, general aviation, and high-performance aircraft and rotorcraft. In addition, the center conducts fundamental research in propulsion-related materials, structures, internal fluid mechanics, instrumentation, controls, and systems. In turbomachinery, the center leverages its computational, analytical, and experimental expertise to improve the reliability and performance of aero-

space vehicles. This federal facility annually receives a total of about \$667 million, at least \$374 million of which directly involves R&D efforts. The center has about 2,074 FTEs, only a portion of whom are involved in R&D activities. A substantial portion of its funds is spent on the maintenance and operation of R&D equipment and facilities. In a recent year, the center awarded over \$167 million of R&D contracts, about \$110 million of which were made to entities based in Ohio.

- While the principal focus of the Louis Stokes VA Medical Center in Cleveland is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 102 projects with total funding of approximately \$9 million. These R&D activities focus on a wide range of topics, including schizophrenia, sleep apnea syndromes, congestive heart failure, and spinal cord injuries.

Columbus, Ohio, is home to the Department of Agriculture's (USDA's) Soil Drainage Research Unit and the Department of Interior's (DOI's) Columbus Field Research Station, Ohio Cooperative Fish and Wildlife Research Units, and Ohio District Office of Water Resources.

- The Soil Drainage Research Unit is part of USDA's Agricultural Research Service (ARS) located on the campus of Ohio State University. It conducts research on the effects of water table management (i.e., drainage, controlled drainage, and subirrigation) and the flooding tolerance of corn and soybean crops in the Midwest. Specific research activities of this unit include studies on the effects of pesticides leaching into the groundwater. A recent project developed strategies for managing water tables to minimize the impact of too much or too little water on crop yields. This federal R&D unit annually receives approximately \$830,000 of federal R&D funds and has about eight FTEs.
- The Columbus Field Research Station is a unit of the Leetown Science Center inside DOI's U.S. Geological Survey (USGS). It

is on the campus of Ohio State University. It conducts research on toxic substances and contaminants that effect the health of fish. Specific research activities of this unit include developing nondestructive sampling techniques with emphasis on Atlantic salmon, techniques for isolation of lake trout herpes virus, Atlantic salmon and sturgeon genetics, and PCR techniques for detection of infectious agents. This federal R&D unit annually receives approximately \$85,000 of federal R&D funds and has one FTE.

- The Ohio Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Ohio State University. It conducts research on the management of fish and wildlife for population ecology and behavioral studies. This federal R&D unit annually receives approximately \$153,000 of federal R&D funds and has about two FTEs. This unit was closed in 1999.
- The Ohio District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.6 million in federal R&D funds.

Coshocton, Ohio, is home to USDA's North Appalachian Experimental Watershed Research Unit.

- The North Appalachian Experimental Watershed Research Unit is part of USDA's ARS located on the Coshocton campus of Ohio State University. It conducts research on the effects of hydrology, surface runoff, groundwater quality, and erosion on agriculture. Specific research activities of the unit include a stochastic simulation of storm occurrence and a comparison of runoff losses of pre- and postemergence herbicides applied to transgenic, herbicide-tolerant corn and soybeans. This federal R&D unit annually receives approximately \$1.1 million of federal R&D funds and has about 14 FTEs.

Dayton, Ohio, is home to the headquarters of DOD's Air Force Research Laboratory Air Vehicles, Materials and Manufacturing, Sensors, Propulsion, and Human Effectiveness Directorates, and a portion of its Information Directorates; Naval Health Research Center Toxicology Detachment; and a regional office of the Defense Technical Information Center; and a DVA R&D unit.

- The Air Vehicles Directorate of is a unit of DOD's Air Force Research Laboratory. It is headquartered at Wright-Patterson Air Force Base (WPAFB), with an additional site in Panama City, Florida. The directorate conducts R&D on aeronautical sciences, control sciences, structures, and integration for aerospace power. It is organized into four technology divisions (Structures, Flight Control, Aeromechanics, and Vehicle Subsystems), which span all R&D areas associated with the conception, analysis, experimental simulation, design, and test of aerospace flight vehicles over the entire flight spectrum. This federal unit annually receives approximately \$79 million of federal R&D funds, only about half of which are spent on in-house R&D activities, and employs about 349 civilians, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Materials and Manufacturing Directorate headquartered at WPAFB is a unit of DOD's Air Force Research Laboratory. It has an additional site in Panama City, Florida. This unit conducts R&D on materials, processes, and manufacturing technologies. Current research activities focus on thermal protection materials, metallic and nonmetallic structural materials, non-destructive inspection methods, materials used in aerospace propulsion systems, and electromagnetic and electronic materials. This federal unit annually receives approximately \$102 million of federal R&D funds, all of which are spent on in-house R&D activities, and has about 417 civilian personnel, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Sensors Directorate headquartered at WPAFB is a unit of DOD's Air Force Research Laboratory. It has additional sites in Rome, New York, and Boston, Massachusetts. This unit conducts R&D on sensors for air and space reconnaissance, surveillance, precision engagement, and electronic warfare applications. Its specific areas of interest include radio frequency sensors and countermeasures, electro-optical sensors and countermeasures, and automatic target recognition and sensor fusion. This federal unit annually receives approximately \$127 million of federal R&D funds, only about 28 percent of which are spent on in-house R&D activities, and employs about 416 civilians, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Propulsion Directorate at WPAFB is a unit of DOD's Air Force Research Laboratory. It is headquartered at WPAFB with an additional site in Lancaster, California. This unit conducts R&D on the technical potential of turbopropulsion systems to advance energy conversion and storage and power generation transmissions. Recent R&D activities include joint efforts to double turbine engine capability by 2003 and to im-

prove reliability and maintainability of aircraft through electric power technologies. This federal unit annually receives approximately \$130 million of federal R&D funds, only about 22 percent of which are spent on in-house R&D activities, and has about 319 civilian personnel. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Human Effectiveness Directorate is a unit of DOD's Air Force Research Laboratory. It is headquartered at WPAFB, with additional sites in San Antonio, Texas, and Mesa, Arizona. The directorate conducts R&D on selecting and training personnel, protecting and sustaining the crew member, and improving human interfaces with weapon systems. The R&D activities at this location focus on crew systems, conducting R&D in such areas as information analysis and exploitation, collaborative systems technology, human interface technology, and visual display systems. This federal unit annually receives approximately \$73 million of federal R&D funds, only about 24 percent of which are spent on in-house R&D activities, and has about 214 civilian personnel, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- The Information Directorate is a unit of DOD's Air Force Research Laboratory. It is headquartered in Rome, New York. The R&D activities at this site include developing consistent battlespace pictures and real-time sensor-to-shooter operations and investigating the uses of information for the soldier. The portion of the directorate at WPAFB annually receives approximately \$7 million of federal R&D funds, only about 16 percent of which are spent on in-house R&D activities, and employs about 76 civilians, only a portion of whom are involved in R&D activities.
- The Naval Health Research Center Toxicology Detachment is a unit of DOD's Naval Health Research Center headquartered in

San Diego, California. The center is the primary location of Navy toxicology R&D. Specifically, the center conducts R&D on reproductive toxicology, cardiac sensitization toxicology, neurobehavioral toxicology, and inhalation toxicology. The center also develops risk assessments and biochemical data necessary to characterize the toxicity of materials. Recent R&D activities have focused on such areas as pulmonary function and software environments for physiologically based pharmacokinetic model simulations. This federal facility annually receives approximately \$1.2 million of federal R&D funds and has about four civilian personnel.

- The Midwestern Regional Office of the Defense Technical Information Center (DTIC) contributes to the R&D efforts by providing access to and facilitating the exchange of scientific and technical information. Specifically, DTIC concentrates on providing information on planned, ongoing, and completed DOD-related R&D to federal agencies and their contractors. This federal unit annually receives approximately \$150,000 of federal R&D funds and employs about two people.
- While the principal focus of the Dayton VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 81 projects with total funding of approximately \$300,000. These R&D activities focus on a wide range of topics, including insomnia, pneumonia, *Haemophilus influenzae*, and ultrasonography.

Delaware, Ohio, is home to USDA's Delaware Forestry Sciences Laboratory.

- The Delaware Forestry Sciences Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on forest ecosystem management. Specific research activities of this lab include developing quantitative methods to monitoring the response of northeastern forest ecosystems to management and environmental stresses, looking

at tree responses to interacting biotic and abiotic stressors, and developing management practices to sustain and improve the health and productivity of northeastern forests. This federal R&D unit annually receives approximately \$2.8 million of federal R&D funds and has about 50 employees.

East Liberty, Ohio, is home to the Department of Transportation's (DOT's) Vehicle Research and Test Center.

- The Vehicle Research and Test Center is a unit inside DOT's National Highway Traffic Safety Administration. It conducts research and vehicle tests on crash avoidance, crashworthiness, and biomechanics. Specific research activities of the center's Pedestrian and Applied Division focus on biomechanics, occupant protection, and crash dummies. Specific research activities of the center's Vehicle Stability and Control Division examine vehicle handling, light vehicle brake systems, vehicle dynamics simulation, Intelligent Transportation Systems (ITS), driver behavior, and heavy trucks. This federal unit annually receives approximately \$12 million in federal R&D funds and has about 25 employees.

Sandusky, Ohio, is home to DOI's Lake Erie Biological Station.

- The Lake Erie Biological Station is a unit of the Great Lakes Science Center inside DOI's USGS. It conducts research on the impact of fish predators, such as the walleye, yellow perch, and lake trout, on fish community structure changes. Specific research interests include food web dynamics and the impacts of exotic species (e.g., zebra mussels) on ecosystems. This federal R&D unit annually receives approximately \$173,000 of federal R&D funds and has about four FTEs.

Wooster, Ohio, is home to USDA's ARS Research Facility at Ohio Agricultural R&D Center.

- The ARS Research Facility at Ohio Agricultural R&D Center is a unit of USDA's ARS located on the Wooster campus of Ohio State University. It consists of three research divisions focusing

on application technology, corn and soybeans, and soft wheat quality. The research on application technology emphasizes technology to protect horticultural, landscape, and field crops against damage from pests and adverse environmental conditions. Specific research activities include studies to reduce conventional pesticide usage while improving coverage with less spray drift. Corn and soybean research focuses on reducing crop losses of corn and soybeans. The research on soft wheat quality focuses on the milling and baking quality of eastern soft wheat cultivars. Specific research activities include measuring kernel characteristics and wheat quality and studying rye translocation genes and quality. This federal R&D unit annually receives approximately \$2.4 million of federal R&D funds and has about 34 FTEs.

FEDERAL R&D GRANTS TO OHIO ENTITIES

Every major institution of higher education in Ohio is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Case Western Reserve University (CWRU), Ohio State University (OSU), the University of Cincinnati, Wright State University (WSU), the Medical College of Ohio (MCO), Ohio University, Kent State University, the University of Toledo, and the University of Dayton. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to OSU are ones from USDA (\$8 million), DOE (\$5 million), and NASA (\$4 million). The comparable grants going to the University of Cincinnati include approximately \$1 million each from the Department of Justice, NASA, and EPA. The grants in this category going to WSU are distributed among EPA, NASA, the Department of Education, and DOE.

Table 36.1 – Sources of Federal R&D Grants to Higher Education in Ohio

Institution	HHS		NSF		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
CWRU	\$124M	538	\$5M	90	\$2M	16	\$2M	33	\$134M	677
OSU	\$54M	323	\$17M	309	\$6M	47	\$21M	386	\$98M	1,065
U of Cincinnati	\$47M	231	\$4M	74	\$1M	13	\$3M	52	\$55M	370
WSU	\$6M	30	\$1M	14	<\$1M	6	\$3M	15	\$10M	65
MCO	\$8M	49	<\$1M	3	0	0	<\$1M	1	\$8M	53
Ohio Univ	\$1M	10	\$2M	34	\$1M	6	\$2M	20	\$6M	70
Kent State	\$2M	14	\$2M	34	<\$1M	2	<\$1M	11	\$4M	61
U of Toledo	\$1M	11	\$1M	22	\$1M	3	\$1M	22	\$4M	58
U of Dayton	<\$1M	1	<\$1M	6	\$2M	6	\$1M	10	\$3M	23
Other	\$7M	72	\$6M	111	<\$1M	5	\$2M	59	\$15M	247
Total	\$250M	1,279	\$38M	697	\$14M	104	\$36M	609	\$337M	2,689

The majority of such grants going to Ohio University come from the Department of Transportation.

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Ohio also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Children’s Hospital Medical Center in Cincinnati (\$32 million), the Cleveland Clinic Foundation (\$30 million), and Battelle Memorial Institute in Columbus (\$24 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Ohio received 192 SBIR awards totaling \$47 million. Examples include a \$1.5 million award from DOD (Air Force) to Frontier

Technology, Inc., in Beavercreek to develop a cost-estimating methodology for advanced air vehicles and a \$750,000 award from DOE to Yellow Springs Optical Sensor in Yellow Springs for work on an optical sensor system for widely dispersed, unattended monitoring of the air-sea exchange of carbon dioxide.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Ohio are ones valued at more than \$5.6 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Ohio every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN OHIO

Several entities in Ohio also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to General Electric Company, which in FY 1998 received close to \$375 million in R&D contracts for such activities as the production of engines for the F-16 fighter for DOD and the Critical Propulsion Components program for NASA. In addition, Lockheed Martin (\$83 million), Battelle Memorial Institute (\$76 million), Camp, Inc. (\$17 million), and Systems Research Laboratory (\$16 million) received very large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Battelle Memorial Institute. The University of Dayton (\$18 million), Case Western Reserve University (\$15 million), and the University of Cincinnati (\$4 million) also received sizable contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are

notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$20 million of federal R&D dollars was also received in FY 1998 by entities in Ohio in the form of cooperative agreements. The largest of these cooperative agreements (\$5 million in FY 1998) came from DOD to Kettering Medical Center for advanced neuroscience interface research. Other federal agencies awarding cooperative agreements to Ohio-based entities include DOC, DOE, and NSF. Among these latter cooperative agreements are awards supporting one of NSF's Science and Technology Centers—the Center for Advanced Liquid Crystalline Optical Materials at Kent State University.

Chapter 37

Federal Research and Development in Oklahoma

- Approximately \$165 million of federal R&D funds are spent each year in Oklahoma.
- Oklahoma ranks 40th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 2 percent of all federal funds spent in Oklahoma each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

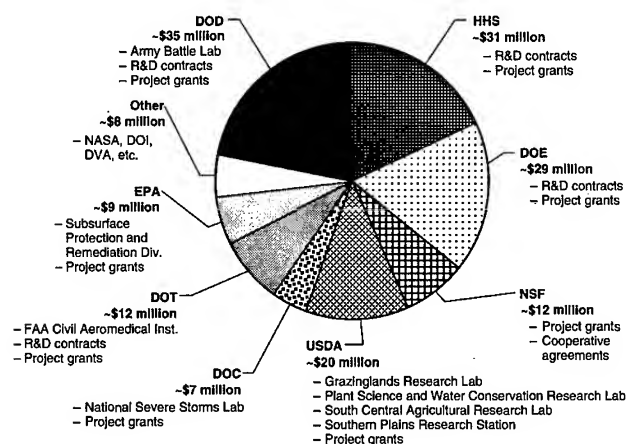


Figure 37.1 – Sources of Federal R&D Dollars Spent in Oklahoma
(Total Federal R&D ~\$165 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$165 million annually in Oklahoma on research and development (R&D) activities. On average, federal R&D dollars account for approximately 2 percent of all federal funds spent in Oklahoma each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Oklahoma. Foremost among these agencies are the Departments of Defense (DOD), Health and Human Services (HHS), Energy (DOE), and Agriculture (USDA), which account for 21, 19, 18, and 12 percent of all federal R&D dollars spent in the state, respectively. The Department of Transportation (DOT), the National Science Foundation (NSF), the Environmental Protection Agency (EPA), and the Department of Commerce (DOC) account for an additional 8, 8, 6, and 4 percent of all federal R&D dollars spent in Oklahoma, respectively. The remaining federal R&D dollars come collectively from the Department of Interior (DOI), the National Aeronautics and Space Administration (NASA), and several other federal agencies.³⁷

All federal R&D dollars spent in Oklahoma either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Oklahoma.

FEDERAL R&D UNITS IN OKLAHOMA

Ada, Oklahoma, is home to the EPA's Subsurface Protection and Remediation Division.

- The Subsurface Protection and Remediation Division is a subunit of the EPA's National Risk Management Research Labora-

³⁷ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

tory headquartered in Cincinnati, Ohio. It conducts research and engages in technical assistance and technology transfer on the chemical, physical, and biological structure and processes of the subsurface environment, the biogeochemical interactions in that environment, and fluxes to other environmental media. Recent research activities include a study on nitrate as an alternate electron acceptor for bioremediation of fuel-contaminated aquifers. This federally owned and operated unit receives approximately \$13.1 million in federal R&D funds and has about 47 FTEs.

El Reno, Oklahoma, is home to USDA's Grazinglands Research Laboratory.

- The Grazinglands Research Laboratory is a unit of USDA's Agricultural Research Service (ARS). It is composed of two divisions focusing on soil and water resources and water quality. It conducts research to enhance forage-livestock and to develop management strategies for grazinglands resources in the Southern Great Plains. Specific research activities of the laboratory include researching forage acceptability, climate change, forage resources, soil-plant-atmosphere dynamics and soil water use, and digestive dynamics of livestock. This R&D unit receives approximately \$4.6 million of federal R&D funds and has about 42 FTEs.

Fort Sill, Oklahoma, is home to DOD's Depth and Simultaneous Attack Battle Laboratory.

- The Depth and Simultaneous Attack Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. It conducts research on the total depth and simultaneous attack battlefield dynamic area, including all related combat and force development efforts to enhance capabilities and achieve effectiveness over all potential adversaries. Specific R&D activities of this laboratory focus on such matters as improving the accuracy of attack systems to increase first round hits, detecting enemy sys-

tems and formations to provide near real-time targeting to commanders and attack systems, and linking intelligence and attack systems in near real-time to optimize targeting of moving and short-dwell targets. This federal unit annually receives about \$745,000 of federal R&D funds, only a portion of which is spent in-house, and has 10 civilian personnel, only a portion of whom are directly involved in R&D activities.

Lane, Oklahoma, is home to USDA's South Central Agricultural Research Laboratory.

- The South Central Agricultural Research Laboratory is a unit of USDA's ARS located on the Lane campus of Oklahoma State University. It conducts research to identify and develop improved germplasm and integrated horticultural crop production systems for the south central United States. Specific research activities of the unit include developing new and environmentally sound integrated disease and insect management systems and investigating the physiological and biochemical mechanisms associated with postharvest diseases and quality of crops. The research is conducted in cooperation with the Oklahoma State University-Wes Watkins Research Laboratory co-located with the lab. This federal R&D unit receives approximately \$1.6 million of federal R&D funds and has about 26 FTEs.

Norman, Oklahoma, is home to DOC's National Severe Storms Laboratory.

- The National Severe Storms Laboratory is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts research on all aspects of severe weather to enhance NOAA's ability to provide timely forecasts and warnings of hazardous weather events, such as blizzards, ice storms, flash floods, tornadoes, and lightning. Specific research activities of the laboratory include developing radar along with satellites, software, and models to study and predict tornadoes, thunderstorms, damaging winds, lightning, gales, winter weather, and flooding. This federal unit annually receives approximately \$6 million of federal R&D funds and has about 51 FTEs.

Oklahoma City, Oklahoma, is home to DOT's Civil Aeromedical Institute, DOI's Oklahoma District Office of Water Resources, and a Department of Veterans Affairs (DVA) R&D unit.

- The Civil Aeromedical Institute is a unit of DOT's Federal Aviation Administration. It studies the factors that influence human performance in the aviation environment. Specifically, it studies the biomedical and human performance aspects of aviation. The institute's toxicology and accident research program evaluates medical findings gleaned from aircraft accidents to improve the safe operation of aircraft. The protection and survival program develops injury-reducing materials and structures and evaluates survival equipment and procedures to protect aircraft occupants. This federal unit annually receives approximately \$8.3 million in federal R&D funds and has about 186 employees, 85 of whom are directly involved in R&D activities.
- The Oklahoma District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.1 million in federal R&D funds.

- While the principal focus of the Oklahoma City VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 214 projects with total funding of approximately \$2 million. These R&D activities focus on a wide range of topics, including drug therapy, catheter ablation, myocardial infarction, autoantibodies, and autoimmunity.

Stillwater, Oklahoma, is home to USDA's Plant Science and Water Conservation Research Laboratory and DOI's Oklahoma Cooperative Fish and Wildlife Research Unit.

- The Plant Science and Water Conservation Research Laboratory is a unit of USDA's ARS located on the Stillwater campus of Oklahoma State University. The laboratory is composed of two divisions focusing on wheat, peanuts, and other field crops and hydraulic engineering. It conducts research to develop alternatives to chemical pesticides to protect plants from insect and disease pests and to develop safe and effective hydraulic structures to control surface water runoff. Specific research activities of the unit include determining the role of noncultivated hosts for aphids and studying ways to introduce useful genetic material into cultured peanut tissue and regenerate transgenic plants with resistance to fungal and viral pathogens. Other activities include developing structures and channels to control, convey, store, and dispose of runoff waters and determining the ability of vegetation and/or various manufactured materials to protect channels from eroding. These federal R&D units combined receive approximately \$2.7 million in R&D funds and have about 31 FTEs.
- The Oklahoma Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Oklahoma State University. It conducts research in fisheries management in reservoirs and rivers; stream ecology; and studies endangered species, threatened species, and species-at-risk. Specific research activities of this unit include conducting aquacultural research and extension projects in cooperation with Langston University.

This federal R&D unit annually receives approximately \$203,000 of federal R&D funds and has about three FTEs.

Woodward, Oklahoma, is home to USDA's Southern Plains Range Research Station.

- The Southern Plains Range Research Station is a unit of USDA's ARS. It conducts research to develop sustainable production practices through improved management of energy flow, nutrient cycling, and hydrologic dynamics for Southern Plains rangeland and associated agricultural ecosystems. Specific research activities of this unit include research into germplasm development and plant physiology and ecology and looking into rangeland soil interactions. This federal R&D unit receives approximately \$1.7 million of federal R&D funds and has about 21 FTEs.

FEDERAL R&D GRANTS TO OKLAHOMA ENTITIES

Every major institution of higher education in Oklahoma is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Oklahoma, Oklahoma State University (OSU), and the University of Tulsa. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and USDA to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Oklahoma include \$2 million from DOD and \$1 million each from EPA, DOE, and NASA. Most of the comparable grants going to Tulsa University are from EPA.

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each

Table 37.1 – Sources of Federal R&D Grants to Higher Education in Oklahoma

	HHS		NSF		USDA		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Oklahoma	\$23M	103	\$7M	97	<\$1M	3	\$6M	50	\$37M	253
OSU	\$2M	18	\$2M	52	\$5M	240	\$1M	26	\$10M	336
U of Tulsa	<\$1M	3	<\$1M	11	<\$1M	1	\$2M	5	\$3M	20
Other	<\$1M	4	<\$1M	1	\$1M	13	<\$1M	6	\$2M	24
Total	\$26M	128	\$10M	161	\$6M	257	\$10M	87	\$52M	633

year to various academic departments within these institutions, such as the Health Sciences Center at the University of Oklahoma.

Several other nonacademic institutions in Oklahoma also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Oklahoma Medical Research Foundation in Oklahoma City (\$8 million), the Federal Aviation Administration in Oklahoma City (\$1 million), and the Underground Injection Practices Research Foundation in Oklahoma City (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Oklahoma received 17 SBIR awards totaling close to \$3 million. Examples include a \$750,000 award from DOE to Commercial Electronics, Inc., in Broken Arrow to develop a low-cost acoustic property sensor for measuring natural gas composition in liquid natural gas powered vehicles and a \$750,000 award from HHS to Sabolich Prosthetic Research Center in Oklahoma City to study intervention methods for individuals with neuropathic feet.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distrib-

ution formula prescribed by law or regulation. Among the formula grants benefiting Oklahoma are ones valued at more than \$4.4 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Oklahoma every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN OKLAHOMA

Several entities in Oklahoma also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to Aeromet, Inc., in Tulsa, which in FY 1998 received close to \$6 million from DOD (Army) to provide general airborne test, measurements support, and meteorological support services for missile range test missions on the U.S. Army Kwajalein Atoll in the Marshall Islands. In addition, DCT, Inc. (\$3 million), Advancia Corp. (\$1 million), and S Systems Corp. (\$1 million) received significant R&D contracts from federal agencies in FY 1998. The University of Oklahoma (\$3 million) and OSU (\$3 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$11 million of federal R&D dollars was also received in FY 1998 by entities located in Oklahoma in the form of cooperative agreements. The largest of these cooperative agreements (\$4.9 million in FY 1998) came from DOC to the University of Oklahoma to operate the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS). Other federal agencies awarding cooperative agreements to Oklahoma-based entities include DOE, USDA, and NSF. Among these latter cooperative agreements is an award supporting one of NSF's Science and Technology Centers—the Center for Analysis and Prediction of Storms at the University of Oklahoma.

Chapter 38

Federal Research and Development in Oregon

- Approximately \$320 million of federal R&D funds are spent each year in Oregon.
- Oregon ranks 31st among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 6 percent of all federal funds spent in Oregon each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

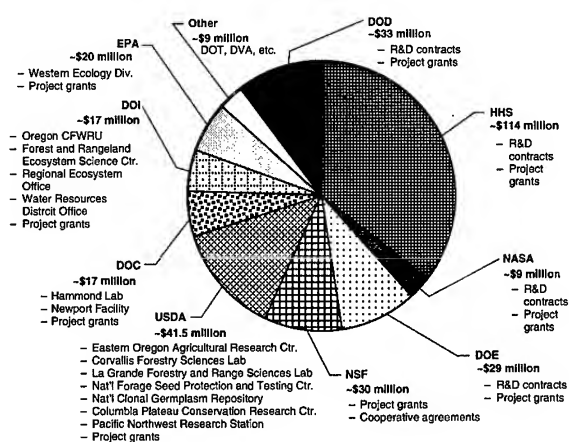


Figure 38.1 – Sources of Federal R&D Dollars Spent in Oregon
(Total Federal R&D ~\$320 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$320 million annually in Oregon on research and development (R&D) activities. On average, federal R&D dollars account for approximately 6 percent of all federal funds spent in Oregon each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Oregon. Foremost among these agencies is the Department of Health and Human Services (HHS), which accounts for 36 percent of all federal R&D dollars spent in the state. The Department of Agriculture (USDA), the Department of Defense (DOD), the National Science Foundation (NSF), and the Department of Energy (DOE) account for an additional 13, 10, 10, and 9 percent of the federal R&D dollars spent in Oregon, respectively. The remaining federal R&D dollars come collectively from the Environmental Protection Agency (EPA), the Departments of Commerce (DOC) and Interior (DOI), and several other federal agencies.³⁸

All federal R&D dollars spent in Oregon either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Oregon.

FEDERAL R&D UNITS IN OREGON

Burns, Oregon, is home to USDA's Eastern Oregon Agricultural Research Center.

- The Eastern Oregon Agricultural Research Center is a unit of USDA's Agricultural Research Service (ARS). It conducts research on rangeland and meadow ecology, restoration of wildlands, environmentally compatible livestock systems, forage

³⁸ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

crops, and alternative grazing strategies. Specific research activities include developing agricultural and natural resource strategies to maintain or enhance intermountain forest and shrub steppes. This federal R&D unit annually receives approximately \$709,000 of federal R&D funds and has about five FTEs.

Corvallis, Oregon, is home to USDA's Corvallis Forestry Sciences Laboratory, National Forage Seed Protection and Testing Center, and National Clonal Germplasm Repository; DOI's Oregon Cooperative Fish and Wildlife Research Units and Forest and Rangeland Ecosystem Science Center; and EPA's Western Ecology Division.

- The Corvallis Forestry Sciences Laboratory is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. The laboratory, which is on the campus of Oregon State University, conducts research on managing coastal forests, developing methods for adjusting riparian reserve boundaries in watershed analysis, and developing simulation models to predict the distribution of ecosystems based on soil and climate features. Specific research activities include identifying patterns of genetic variation in native populations of forests plants, developing aquatic and riparian effectiveness-monitoring strategies, and developing pheromones to manage insect populations. This federal R&D unit annually receives approximately \$8 million of federal R&D funds and has about 170 employees.
- The National Forage Seed Protection and Testing Center is a unit of USDA's ARS located on the campus of Oregon State University. It consists of two divisions that focus on forage seed and cereal research and horticultural crops research. It conducts research to develop seed production systems of temperate grasses and legumes and to understand the physiology, pathology, and genetics of a wide range of horticultural crops. Specific research activities of this unit include studying seedborne diseases of grasses, genetic integrity of grass cultivars, weed management in grass seed production; managing microorganisms; and on-farm grass straw utilization. Other research activities in-

clude investigating biological control, beneficial microorganisms, and fundamental aspects of horticultural crop growth and development. These federal R&D units, in combination with the unit below, annually receive approximately \$6.8 million of federal R&D funds and have about 84 FTEs.

- The National Clonal Germplasm Repository is a unit of USDA's ARS located on the campus of Oregon State University. It maintains collections representing global diversity of hazelnuts, strawberries, hops, mint, pears, currants, gooseberries, raspberries, blackberries, blueberries, and cranberries. Cultivars (clones) are stored as growing plants, while wild species are generally preserved as seed. Specific research activities of this unit include conducting experiments to improve cryopreservation. This federal R&D unit's R&D funding and employment information is included in the above description.
- The Oregon Cooperative Fish and Wildlife Research Units are part of DOI's U.S. Geological Survey (USGS). They are on the campus of Oregon State University. They conduct research on forest wildlife management, particularly as related to wildlife and habitat relationships associated with old-growth areas as well as environmental contaminants. Specific research activities of these units include environmental physiology of fish and genetics, forest-wildlife relationships, wildlife population analysis, and environmental contaminants. Combined, these federal R&D units annually receive approximately \$376,000 of federal R&D funds and have about four FTEs.
- The Forest and Rangeland Ecosystem Science Center is a unit of DOI's USGS. Its headquarters office is on the campus of Oregon State University. It conducts research to support management and conservation of forest and rangeland ecosystems in the Pacific Northwest and Intermountain West. It uses a multidisciplinary approach combining forestry, wildlife ecology, rangeland ecology, aquatic ecology, environmental toxicology, conservation genetics, and information science. The center provides assistance to resource managers in proximity to its headquarters

and six field stations. Specific research activities of this unit include environmental physiology of fish and genetics, forest-wildlife relationships, wildlife population analysis, and environmental contaminants. This federal R&D unit annually receives approximately \$3.9 million of federal R&D funds and has about 27 FTEs.

- The Western Ecology Division is a unit of the EPA's National Health and Environmental Effects Research Laboratory headquartered in Research Triangle Park, North Carolina. It conducts experiments, field studies, modeling, and data analysis on ecological systems and on ecological phenomena at the ecosystem, landscape, and regional scales. Ongoing research activities include studies of below-ground linkages in forest ecosystems, the impact of ecological disturbances on eelgrass habitat, and the structure of landscape-scale ecosystems in the Oregon Cascades. Other activities include quantifying estuarine biota-habitat relationships, studies of microbial and other ecologic and chemical indicators of aquatic environments, and an examination of the effect of ozone and carbon dioxide on the ponderosa pine plant/litter/soil system. This federal R&D unit annually receives about \$17.6 million of federal R&D funds and has about 78 FTEs.

Hammond, Oregon, is home to DOC's Hammond Laboratory.

- Hammond Laboratory is a unit of the Northwest Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). The laboratory coordinates research with the center in the areas of conservation biology, environmental conservation, fishery resources analysis and monitoring, fish ecology, and resource enhancement and utilization technologies. It also conducts research on salmon and groundfish of the Columbia River. Specific research activities of this unit focus on salmon conservation, coastal ecology, and environmental monitoring of the Columbia River. This federal unit annually receives approximately \$200,000 of federal R&D funds and has one FTE.

La Grande, Oregon, is home to a unit of USDA's La Grande Forestry and Range Sciences Laboratory.

- The La Grande Forestry and Range Sciences Laboratory is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. It conducts research on understanding the ecological linkages of insects and microbes with keystone birds, mammals, and their habitat requirements. Specific research activities of this laboratory include studies on the ecological interactions among elk, deer, and cattle and plant succession and disturbance processes. This federal R&D unit annually receives approximately \$2.4 million of federal R&D funds and has about 38 employees.

Newport, Oregon, is home to DOC's Newport Facility.

- The Newport Facility is a unit of the Northwest Fisheries Science Center inside DOC's NOAA. The facility coordinates research with the center in the areas of conservation biology, environmental conservation, fishery resources analysis and monitoring, fish ecology, and resource enhancement and utilization technologies. It also conducts research on shore ecology, parasitology, invertebrate zoology, microbiology, neurophysiology, fish disease, fisheries aquaculture, toxiculture, and oceanography. This federal unit annually receives approximately \$1.2 million of federal R&D funds and has about 15 FTEs. It also annually receives an additional \$653,000 of federal R&D funds and another seven FTEs from the Alaska Fisheries Science Center.

Pendleton, Oregon, is home to USDA's Columbia Plateau Conservation Research Center.

- The Columbia Plateau Conservation Research Center is a unit of USDA's ARS. The center conducts research in wind and water erosion that affects dryland farming areas on and near the Columbia Plateau. Specific research activities of this center include studies in erosion prediction and control; fertility and soil/water

impacts on cereals and legumes; pest management strategies; and other topics in soil science, hydrology, agricultural engineering, and plant physiology. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about 20 FTEs.

Portland, Oregon, is home to USDA's Pacific Northwest Research Station, DOI's Regional Ecosystem Office and Oregon District Office of Water Resources, and a Department of Veterans Affairs (DVA) R&D unit.

- The Pacific Northwest Research Station, headquartered in Portland, is a unit of USDA's Forest Service. It conducts research on the theory and practice of adaptive management, financial and utilization potential of prospective land management, and biology and culture of forest plants. Specific research activities of this research station include studies related to the range of northern spotted owls in Oregon, compatibility between wood production and other forest values and uses on federal lands, insect disease and fire disturbance in eastern Oregon, and issues centered on relicensing of dams, water-centered recreation, water quality, and municipal watershed. This federal R&D unit annually receives approximately \$6 million of federal R&D funds and has about 68 employees.
- The Regional Ecosystem Office of the Forest and Rangeland Ecosystem Science Center is a unit of DOI's USGS. It consists of a single scientist who is directly affiliated with the center's headquarters in Corvallis, Oregon. He conducts research to facilitate the Regional Interagency Executive Committee and Intergovernmental Advisory Committee decisionmaking and to prompt interagency issue resolution in support of implementation of the Northwest Forest Plan (NFP). Specific research efforts of this office focus on NFP's comprehensive long-term management activities for 19 national forests and six Bureau of Land Management districts in Oregon, Washington, and California. This federal R&D unit annually receives approximately \$103,000 of federal R&D funds and has one FTE.

- The Oregon District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.5 million in federal R&D funds.
- While the principal focus of the Portland VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 313 projects with total funding of approximately \$6 million. These R&D activities focus on a wide range of topics, including multiple sclerosis, osteoporosis, cell biology, and substance dependence.

FEDERAL R&D GRANTS TO OREGON ENTITIES

Every major institution of higher education in Oregon is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Oregon Health Sciences Uni-

versity (OHSU), Oregon State University (OSU), the University of Oregon, Oregon Graduate Institute of Science and Technology (OGI), and Portland State University (PSU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to OSU are ones from USDA (\$7 million), EPA (\$6 million), NASA (\$4 million), and DOC (\$3 million). The comparable grants going to the University of Oregon include \$1 million each from DOE and the Department of Education. Those going to PSU come mainly from the Department of Education.

Table 38.1 – Sources of Federal R&D Grants to Higher Education in Oregon

Institution	HHS		NSF		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
OHSU	\$61M	356	\$1M	10	\$1M	1	\$1M	9	\$63M	376
OSU	\$8M	49	\$14M	202	\$6M	47	\$21M	380	\$50M	678
U of Oregon	\$13M	76	\$8M	156	\$2M	13	\$3M	53	\$26M	298
OGI	\$2M	13	\$2M	22	\$2M	11	\$1M	6	\$7M	52
PSU	\$1M	5	<\$1M	9	<\$1M	2	\$1M	10	\$2M	26
Other	\$1M	7	<\$1M	12	0	0	<\$1M	9	\$1M	28
Total	\$86M	506	\$25M	411	\$10M	74	\$27M	467	\$148M	1,458

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Oregon also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Oregon Regional Primate Research Center in Beaverton (\$18 million), the Sisters

of Providence Health System in Portland (\$11 million), the Oregon Research Institute in Eugene (\$10 million), and the Oregon Social Learning Center in Eugene (\$6 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Oregon received 55 SBIR awards totaling \$15 million. Examples include a \$750,000 award from the Army to Flow, Inc., in Portland for work on a rapid test for malaria diagnosis and treatment and a \$750,000 award from HHS to the Oregon Center for Applied Science in Eugene to develop comprehension and spelling programs for the hearing impaired.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Oregon are ones valued at more than \$3.3 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Oregon every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN OREGON

Several entities in Oregon also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. A large share of the funds go to Templex Technology Corporation, which in FY 1998 received close to \$2 million in R&D contracts from DOD for its development of innovative optical networking technology. In addition, Bend Research, Inc. (\$1 million),

Hood Technology Corp. (\$1 million), Flir Systems, Inc. (\$1 million), and the Kaiser Foundation (\$1 million) received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. For example, Bend Research received over \$1 million in federal grants in FY 1998. OGI (\$2 million), OSU (\$2 million), and OHSU (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$19 million of federal R&D dollars was also received in FY 1998 by entities located in Oregon in the form of cooperative agreements. The largest of these cooperative agreements (\$2 million in FY 1998) went from the Department of Interior to OSU to conduct research in natural systems management relating to forest and rangeland ecosystems in the Pacific Northwest. Other federal agencies awarding cooperative agreements to Oregon-based entities include DOC and USDA.

Chapter 39

Federal Research and Development in Pennsylvania

- Approximately \$2.3 billion of federal R&D funds are spent each year in Pennsylvania.
- Pennsylvania ranks 12th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 10 percent of all federal funds spent in Pennsylvania each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

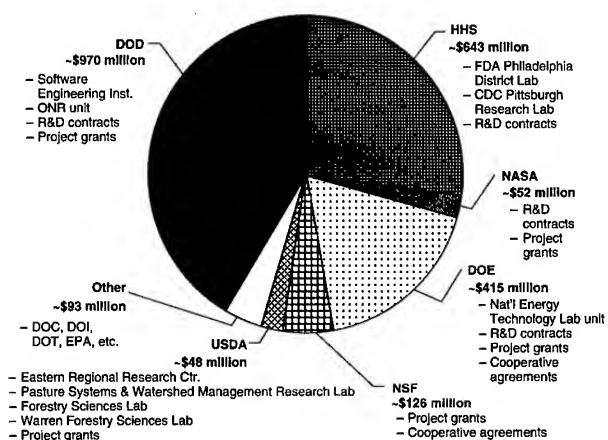


Figure 39.1 – Sources of Federal R&D Dollars Spent in Pennsylvania
(Total Federal R&D ~\$2.3 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$2.3 billion annually in Pennsylvania on research and development (R&D) activities. On average, federal R&D dollars account for approximately 10 percent of all federal funds spent in Pennsylvania each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Pennsylvania. Foremost among these agencies are the Departments of Defense (DOD), Health and Human Services (HHS), and Energy (DOE) which account for 41, 27, and 18 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), and the Department of Agriculture (USDA) account for an additional 5, 2, and 2 percent of the federal R&D dollars spent in Pennsylvania, respectively. The remaining federal R&D dollars come collectively from the Departments of Commerce (DOC) and Interior (DOI) and several other federal agencies.³⁹

All federal R&D dollars spent in Pennsylvania either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Pennsylvania.

FEDERAL R&D UNITS IN PENNSYLVANIA

Lemoyne, Pennsylvania, is home to DOI's Pennsylvania District Office of Water Resources.

- The Pennsylvania District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment

³⁹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

(NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$2 million in federal R&D funds.

Newtown Square, Pennsylvania, is home to USDA's Forestry Sciences Laboratory.

- The Forestry Sciences Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on forest ecosystem management. Specific research activities of this lab include developing quantitative methods to monitor the response of northeastern forest ecosystems to management and environmental stresses, looking at tree responses to interacting biotic and abiotic stressors, and developing management practices to sustain and improve the health and productivity of northeastern forests. This federal R&D unit annually receives approximately \$4.8 million of federal R&D funds and has about 50 employees.

Philadelphia, Pennsylvania, is home to a unit of DOD's Office of Naval Research, HHS's Philadelphia District Laboratory, and a Department of Veterans Affairs (DVA) R&D unit.

- The R&D Management Command is a unit of the Office of Naval Research (ONR) inside DOD. ONR is headquartered in

Arlington, Virginia, and provides R&D managers to oversee the extramural R&D programs of the Navy and Marine Corps performed by universities, nonprofit organizations, or for-profit companies. ONR sponsors extramural R&D programs in information, electronics, and surveillance; ocean, atmosphere, and space; engineering, materials, and physical science; human systems; and naval expeditionary warfare. This federal unit annually receives approximately \$779,000 of federal R&D funds to support the in-house management activities of about 10 full-time equivalent employees (FTEs).

- The Philadelphia District Laboratory is a unit of HHS's Food and Drug Administration. It conducts research on the safety and efficacy of human drugs. This federal unit annually receives approximately \$407,000 of federal R&D funds and has about five FTEs directly involved in R&D activities.
- While the principal focus of the Philadelphia VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 270 projects with total funding of approximately \$4 million. These R&D activities focus on a wide range of topics, including substance abuse treatment and rheumatology-immunology.

Pittsburgh, Pennsylvania, is home to DOD's Software Engineering Institute, HHS's Pittsburgh Research Laboratory, DOE's National Energy Technology Laboratory-Pittsburgh, DOI's Pennsylvania Cooperative Fish and Wildlife Research Unit, and a DVA R&D unit.

- The Software Engineering Institute is a federally funded research and development center (FFRDC) sponsored by the Office of the Under Secretary of Defense for Acquisition and Technology and operated by Carnegie Mellon University. It focuses exclusively on advancing the practice of software engineering because software is such a critical part of U.S. defense systems. It seeks to ensure that operational software in software-intensive systems, be they defense or nondefense systems, is of the highest

quality possible. Specific R&D activities of the institute focus on management practices of software producers, especially as they affect quality and productivity, and on the technical practices of the industry as they affect the ability of software engineers to understand and control the functional and nonfunctional aspects of software systems. This federally owned and contractor-operated unit annually receives approximately \$38 million of federal R&D funds and has about 400 employees.

- The Pittsburgh Research Laboratory is a unit of the National Institute of Occupational Safety and Health (NIOSH) inside HHS's Centers for Disease Control and Prevention (CDC). It conducts research to promote the health and safety of miners by investigating ways to reduce dust and noise in the mine environment and improving the safety of explosives and blasting practices. Specific research activities of this unit include developing a coal combustion-sensitive test for smoke detectors, studying ways to detect and control spontaneous heating in coal mine pillars, and studying the performance of automatic sprinklers for extinguishing belt fires under ventilated conditions. This federal R&D unit annually receives approximately \$18.4 million in federal R&D funds and has about 228 FTEs.
- The National Energy Technology Laboratory-Pittsburgh, formerly a part of the Federal Energy Technology Center, is a unit of DOE. It is affiliated with the National Energy Technology Laboratory-Morgantown in West Virginia. It develops technologies related to coal, oil, and natural gas (i.e., fossil energy) and environmental cleanup. Specifically, the laboratory focuses on advancing the commercialization of pollution-reduction technologies, the more efficient use of fossil fuels, and developing technologies to clean up DOE-managed and -generated waste. While the laboratory maintains a modest in-house R&D capability, most of its staff oversees extramural R&D projects conducted with federal R&D funds. This federal laboratory annually receives approximately \$87 million of total funds, only about \$11 million of which is spent on R&D activities conducted on-site. The laboratory has about 143 employees.

- The Pennsylvania Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Pennsylvania State University. It conducts research on fish and wildlife populations. Specific research activities of this unit include studies of deer populations and the effects of agricultural activities on trout streams. This federal R&D unit annually receives approximately \$203,000 of federal R&D funds and has about two FTEs.
- While the principal focus of the VA Medical Centers in Pittsburgh is providing medical care to veterans, they are also the location of a number of research activities. In a recent year, these federally owned and operated facilities were the site of 236 projects with total funding of approximately \$3 million. These R&D activities focus on a wide range of topics, including schizophrenia, sleep and cognitive disorders, aging, alcoholism, nephrology, oncology, urology, and vascular surgery.

University Park, Pennsylvania, is home to USDA's Pasture Systems and Watershed Management Research Laboratory.

- The Pasture Systems and Watershed Management Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of Pennsylvania State University. It conducts research to develop land, water, and plant management systems to preserve the quality of ground and surface waters in the Northeast and to ensure that crop production and grazing can be sustained profitably. Specific research activities of this unit include developing technology to reduce off-frame inputs of feed, fuel, and chemicals and identifying the effects of land management on water quality and quantity. This federal R&D unit annually receives approximately \$3.2 million of federal R&D funds and has about six FTEs.

Warren, Pennsylvania, is home to the USDA's Warren Forestry Sciences Laboratory.

- The Warren Forestry Sciences Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It con-

ducts research on ecosystem management. Specific research activities of this lab include studying regeneration and forest renewal and investigating the sugar maples in the Allegheny Plateau forests. This federal R&D unit annually receives approximately \$950,000 of federal R&D funds and has about 16 employees.

Wellsboro, Pennsylvania, is home to DOI's Research and Development Laboratory.

- The Research and Development Laboratory is a unit of the Leetown Science Center inside DOI's USGS. It conducts research on the restoration of depleted fisheries and other aquatic biological resources. Specific research activities of this unit include developing information and technology to better understand the aquatic ecosystems in the northeastern United States. Recently, this has included developing the National Fish Broodstock Database and enhancing the feeding ecology of double-crested cormorants in Lake Ontario. This federal R&D unit annually receives approximately \$955,000 of federal R&D funds and has about 19 FTEs.

Wyndmoor, Pennsylvania, is home to USDA's Eastern Regional Research Center.

- The Eastern Regional Research Center is a unit of USDA's ARS. It consists of seven research divisions—the Dairy Products Research Laboratory; the Engineering Science Research Laboratory; the Food Safety Research Laboratory; the Hides, Lipids and Wool Research Laboratory; the Microbial Food Safety Research Laboratory; the Plant Science and Technology Research Laboratory; and the Plant-Soil Biophysics Core Technologies Laboratory. The center conducts research on agricultural commodities, including milk, meat, hides, leather, wool, fats, oils, fruits, vegetables, and juices, to ensure food quality and safety. Specific research activities of this center include biophysical and biochemical research on the use of soil fungi for plant nutrient uptake and on the development of biosensors for detect-

ing pathogenic bacteria in food, developing technology to lower costs for feedstock, and developing technology in ethanol production that will improve competitiveness of ethanol as a fuel or fuel additive. This federal R&D unit annually receives approximately \$22.3 million of federal R&D funds and has about 215 FTEs.

Coatesville and Lebanon, Pennsylvania, are home to VA Medical Centers. While the principal focus of these federally owned and operated facilities is providing medical care to veterans, each center is also the location of a number of research activities. In a recent year, these federally owned and operated facilities were the site of 58 R&D projects with total funding of less than \$300,000. These R&D activities focus on a wide range of topics, including diabetes, Alzheimer's disease, congestive heart failure, and substance abuse.

FEDERAL R&D GRANTS TO PENNSYLVANIA ENTITIES

Every major institution of higher education in Pennsylvania is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Pennsylvania (U of Penn), Pennsylvania State University (PSU), the University of Pittsburgh (Pitt), Thomas Jefferson University (TJU), MCP Hahnemann University (formerly Allegheny University of the Health Sciences) (MCPHU), Temple University, Carnegie Mellon University (CMU), Lehigh University, and Villanova University. The table below shows the total number of R&D grants that were active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to PSU are \$9 million from USDA, \$6 million from NASA, \$4 million from DOE, and \$3 million from the Environmental Protection Agency (EPA). Almost all of the grants in

Table 39.1 – Sources of Federal R&D Grants to Higher Education in Pennsylvania

Institution	HHS		NSF		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Penn	\$245M	1,010	\$13M	214	\$9M	46	\$10M	83	\$277M	1,353
PSU	\$30M	185	\$24M	444	\$19M	112	\$25M	538	\$98M	1,279
Pitt	\$167M	664	\$13M	208	\$8M	32	\$4M	51	\$192M	955
TJU	\$56M	262	\$1M	7	<\$1M	2	<\$1M	3	\$57M	274
MCPHU	\$34M	185	\$1M	7	\$1M	4	<\$1M	5	\$36M	201
Temple	\$24M	121	\$2M	29	\$1M	2	\$1M	17	\$27M	169
CMU	\$9M	63	\$23M	253	\$11M	52	\$8M	65	\$51M	433
Lehigh	\$1M	9	\$3M	81	\$4M	19	\$1M	14	\$9M	123
Villanova	<\$1M	2	\$1M	10	\$1M	4	<\$1M	14	\$2M	30
Other	\$7M	57	\$7M	159	\$4M	9	\$2M	49	\$21M	274
Total	\$573M	2,558	\$88M	1,412	\$57M	282	\$53M	839	\$771M	5,091

this same category going to U of Penn (\$8 million of the \$10 million) are from DOE.

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Medical School at the U of Penn.

Several other nonacademic institutions in Pennsylvania also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Children’s Hospital of Philadelphia (\$34 million), Milton S. Hershey Medical Center in Hershey (\$29 million), Fox Chase Cancer Center in Philadelphia (\$28 million), Wistar Institute in Philadelphia (\$17 million), and Concurrent Technologies Corporation of Harrisburg, Johnstown, Pittsburgh, and West Chester (\$11 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extra-

mural R&D of more than \$100 million. In a recent year, small businesses in Pennsylvania received 154 SBIR awards totaling \$41 million. Examples include a \$600,000 award from DOD (Navy) to Unistry Associates, Inc., in Havertown for work on protection of Naval computers from denial-of-service attacks and a \$250,000 award from the Department of Education to Dancing Dots Braille Music Technology in Upper Darby for work on the conversion of Score™ files to music Braille.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Pennsylvania are ones valued at more than \$6.1 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) going to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Pennsylvania every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN PENNSYLVANIA

Several entities in Pennsylvania also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far, the majority of these funds go in the form of contracts from DOD to Boeing-Sikorsky and the Pennsylvania-based divisions of Lockheed Martin, which in FY 1998 received \$199 million and \$64 million, respectively, in contracts for R&D work on the Comanche helicopter. Note that both companies also receive a significant amount of funds from DOD for non-R&D work on this project. In addition, Concurrent Technologies Corporation received \$82 million of R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Concurrent Technologies Corporation. Pennsylvania-based units of

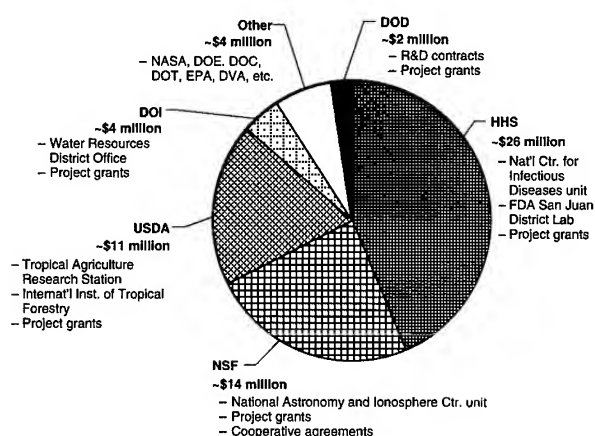
United Defense and General Electric also received \$37 million and \$30 million, respectively, in federal R&D contract funds in FY 1998. CMU, U of Penn, and PSU also received contracts from various federal agencies to conduct R&D for the federal government, which totaled several million dollars for each university. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$160 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities located in Pennsylvania. By far the largest of these cooperative agreements came from DOE for a project in Allentown involving the development of power plant clean coal technology. Other parties involved in this federally supported R&D project include the city of Lakeland in Florida, Foster Wheeler Corporation, and Siemens Westinghouse Corporation. Other federal agencies awarding cooperative agreements to Pennsylvania-based entities include DOD and NSF. Among these latter cooperative agreements are awards supporting two of NSF's Science and Technology Centers—the Center for Light Microscope Imaging and Biotechnology at CMU and the Center for Research in Cognitive Science at U of Penn. In addition, Pennsylvania is home to two of NSF's Materials Research Science and Engineering Centers—the Mesoscale Interface Mapping Project at CMU and the Laboratory for Research on the Structure of Matter at the U of Penn.

Chapter 40

Federal Research and Development in Puerto Rico

- Approximately \$59 million of federal R&D funds are spent each year in Puerto Rico.
- Puerto Rico ranks 48th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 1 percent of all federal funds spent in Puerto Rico each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.



**Figure 40.1 – Sources of Federal R&D Dollars Spent in Puerto Rico
(Total Federal R&D ~\$59 million)**

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$59 million annually in Puerto Rico on research and development (R&D) activities. On average, federal R&D dollars account for approximately 1 percent of all federal funds spent in Puerto Rico each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Puerto Rico. Foremost among these agencies is the Department of Health and Human Services (HHS), which accounts for 43 percent of all federal R&D dollars spent in the state. The National Science Foundation (NSF) and the Department of Agriculture (USDA) account for an additional 24 and 19 percent of all federal R&D dollars spent in Puerto Rico, respectively. The remaining federal R&D dollars come collectively from the Department of Interior (DOI), the National Aeronautics and Space Administration (NASA), and several other federal agencies.⁴⁰

All federal R&D dollars spent in Puerto Rico either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Puerto Rico.

FEDERAL R&D UNITS IN PUERTO RICO

Arecibo, Puerto Rico, is home to NSF's National Astronomy and Ionosphere Center.

- The National Astronomy and Ionosphere Center (NAIC) is a federally funded research and development center (FFRDC) sponsored by the National Science Foundation, headquartered at Cornell University, and physically located in Puerto Rico. NAIC's Arecibo Observatory conducts research in astronomy

⁴⁰ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

and atmospheric sciences. It also develops new techniques and instruments for astronomical and atmospheric observations and data processing. The Arecibo Radio Telescope enables astronomers to detect the faint radio emissions from the universe. Experiments performed at the observatory help scientists measure the upper atmosphere composition, temperature, and densities. This federally owned and university operated unit annually receives a total of approximately \$12 million of federal R&D funds, close to \$9 million of which are spent in Puerto Rico. About 140 people are employed by NAIC in Puerto Rico.

Guaynabo, Puerto Rico, is home to DOI's Puerto Rico District Office of Water Resources.

- The Puerto Rico District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1 million in federal R&D funds.

Mayagüez, Puerto Rico, is home to a unit of USDA's Tropical Agriculture Research Station.

- The Tropical Agriculture Research Station is a unit of USDA's Agricultural Research Service (ARS) located on the campus of the University of Puerto Rico. It conducts fundamental re-

search on tropical plants and studies crops. Specific research activities of the unit include studies to enhance sorghum germplasm and investigation of different ways to increase resistance and improve the quality of dry beans. This federal R&D unit annually receives approximately \$2.4 million in federal R&D dollars and has about 37 FTEs.

Rio Piedras, Puerto Rico, is home to USDA's International Institute of Tropical Forestry.

- The International Institute of Tropical Forestry is a unit of USDA's Forest Service. It conducts research on tropical American forestry management practices. Specifically, the unit studies ways to decrease the impacts and extent of tropical deforestation and strengthen tropical forest management. This federally R&D unit receives approximately \$2.9 million in federal R&D dollars and has about 73 employees.

San Juan, Puerto Rico, is home to HHS's San Juan District Laboratory and the Dengue Branch of the Division of Vector-Borne Infectious Diseases and a Department of Veterans Affairs (DVA) R&D unit.

- The San Juan District Laboratory is a unit of HHS's Food and Drug Administration. It conducts research on the safety and efficacy of human drugs. This federal unit receives approximately \$163,000 in federal R&D dollars and has one FTE directly involved in R&D activities.
- The Dengue Branch of the Division of Vector-Borne Infectious Diseases (DVBID) in Fort Collins, Colorado, is a unit of the National Center for Infectious Diseases inside HHS's Centers for Disease Control and Prevention (CDC), which is headquartered in Atlanta, Georgia. It conducts research to provide laboratory and clinical diagnoses and national and international surveillance, prevention, and control of dengue and dengue hemorrhagic fever as well as providing laboratory reference and diagnostic services to local, state, national, and international health agencies. It is organized in three sections: Epidemiology,

Diagnostic and Reference, and Entomology. Specific research activities of this branch include investigating dengue epidemics and providing aid; conducting field and laboratory research on the biology, behavior, and control of *Aedes aegypti* and other mosquito vectors of dengue; and developing new community-based intervention strategies for prevention of epidemic dengue. The Dengue Branch also serves the diagnostic and reference functions of the World Health Organization's Collaborating Center for Reference and Research on Dengue Hemorrhagic Fever. This federal unit annually receives approximately \$517,000 of federal R&D funds and has about 16 FTEs.

- While the principal focus of the San Juan VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 99 projects with total funding of approximately \$25,000. These R&D activities focus on a wide range of topics, including renal physiology, endocrinology, dental implants, infectious diseases, urology, hematology-oncology, cardiology, and hypertension.

FEDERAL R&D GRANTS TO PUERTO RICO ENTITIES

Every major institution of higher education in Puerto Rico is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, USDA, and NSF to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Puerto Rico (U of Puerto Rico), the Ponce School of Medicine (PSM), and Universidad Central Del Caribe (UCDC). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, USDA, and NSF to parties at these institutions and estimates of the total dollars transferred to them pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Puerto Rico are ones from NASA (\$2 million), DOD (\$1 million), and DOC (\$1 million).

Table 40.1 – Sources of Federal R&D Grants to Higher Education in Puerto Rico

	HHS		USDA		NSF		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Puerto Rico	\$18M	46	\$4M	64	\$4M	50	\$5M	33	\$31M	193
PSM	\$4M	5	0	0	0	0	<\$1M	2	\$4M	7
UCDC	\$3M	5	0	0	0	0	0	0	\$3M	5
Other	\$1M	5	<\$1M	1	<\$1M	2	<\$1M	2	\$1M	10
Total	\$26M	61	\$4M	65	\$4M	52	\$6M	37	\$40M	215

These activities are particularly significant because they fund much of the “basic research” so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Puerto Rico also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Seguros de Servicio de Salud in San Juan (\$200,000), San Juan City Hospital (\$200,000), and the Governor’s Office of Elderly Affairs (\$150,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, one small business in Puerto Rico received an SBIR award. This was an \$86,000 award from HHS to Innovaciones Psicoeducativas in Rio Piedras for work on the identification of learning and developmental disabilities.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Puerto Rico are ones valued at more than \$3.8 million

from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Puerto Rico every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN PUERTO RICO

Several entities in Puerto Rico also received notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The two contracts active in FY 1998 went to the University of Puerto Rico, which received close to \$200,000 from DOD (Army) and HHS.

A total of \$2.5 million of federal R&D dollars was also received in FY 1998 by entities located in Puerto Rico in the form of cooperative agreements. By far the largest of these cooperative agreements (\$2 million in FY 1998) came from NSF to the University of Puerto Rico in San Juan to fund the Puerto Rico Collaborative for Excellence for Teacher Preparation (PR-CEPT). Other federal agencies awarding cooperative agreements to Puerto Rico-based entities include the Department of Commerce and USDA.

Chapter 41

Federal Research and Development in Rhode Island

- Approximately \$515 million of federal R&D funds are spent each year in Rhode Island.
- Rhode Island ranks 25th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 22 percent of all federal funds spent in Rhode Island each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

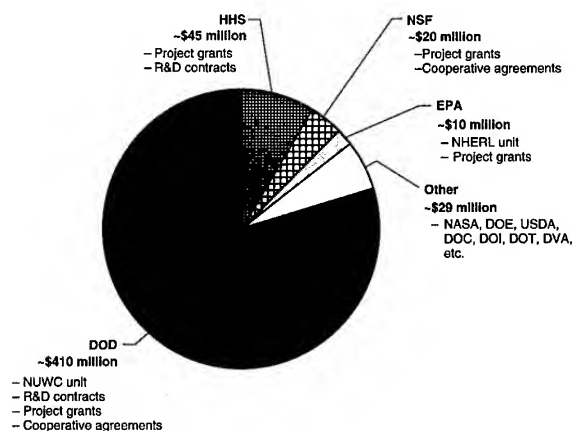


Figure 41.1 – Sources of Federal R&D Dollars Spent in Rhode Island
(Total Federal R&D ~\$515 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$515 million annually in Rhode Island on research and development (R&D) activities. On average, federal R&D dollars account for approximately 22 percent of all federal funds spent in Rhode Island each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Rhode Island. Foremost among these agencies is the Department of Defense (DOD), which accounts for 80 percent of all federal R&D dollars spent in the state. The Department of Health and Human Services (HHS) and the National Science Foundation (NSF) account for an additional 9 and 4 percent of all federal R&D dollars spent in Rhode Island, respectively. The remaining federal R&D dollars come collectively from the Departments of Commerce (DOC), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and several other federal agencies.⁴¹

All federal R&D dollars spent in Rhode Island either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Rhode Island.

FEDERAL R&D UNITS IN RHODE ISLAND

Narragansett, Rhode Island, is home to DOC's Narragansett Laboratory and the Environmental Protection Agency's (EPA's) Atlantic Ecology Division.

- The Narragansett Laboratory is a unit of the Northeast Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration. It conducts research on ocean circula-

⁴¹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

tion, nutrients, temperature fluctuations, and fish populations as related to fish life cycles. Specifically, research activities focus on environmental processes and fisheries ecology with specific investigations in marine climatology, early life history dynamics, plankton ecology, and apex predator ecology. This federal unit annually receives approximately \$2.4 million of federal R&D dollars and has about 34 FTEs, only a portion of whom are involved in R&D activities.

- The Atlantic Ecology Division is a unit of EPA's National Health and Environmental Effects Research Laboratory headquartered in Research Triangle Park, North Carolina. The division conducts studies in marine, coastal, and estuarine water quality. It also develops and evaluates theory, methods, and data to better understand and quantify the environmental effects of anthropogenic stressors on the coastal waters and watershed of the Atlantic seaboard. This federal unit annually receives approximately \$9.7 million in federal R&D dollars and has about 82 FTEs.

Newport, Rhode Island, is home to DOD's Naval Undersea Warfare Center Newport Division.

- The Naval Undersea Warfare Center Newport Division is a unit of DOD. It conducts R&D with a strong emphasis on basic research, performs system and component prototyping, and develops entire ship's systems. This federal unit annually receives approximately \$169 million in federal R&D dollars for in-house activities and has about 2,901 civilian personnel, only a portion of whom are involved in R&D activities.

Providence, Rhode Island, is home to a Department of Veterans Affairs R&D unit.

- While the principal focus of the Providence VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 97 projects with total funding of approximately \$2 million. These R&D activities

focus on a wide range of topics, including alcoholism, congestive heart failure, schizophrenia, bipolar disorder, neoplasms, and depression.

FEDERAL R&D GRANTS TO RHODE ISLAND ENTITIES

Every major institution of higher education in Rhode Island is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as Brown University and the University of Rhode Island (URI). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to Brown University are close to \$2 million each from DOE and NASA. Most of the comparable grants going to URI are provided by DOC (\$2.5 million) and USDA (\$2 million).

Table 41.1 – Sources of Federal R&D Grants to Higher Education in Rhode Island

	HHS		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
Brown	\$21M	131	\$8M	168	\$6M	35	\$4M	54	\$39M	388
URI	\$6M	16	\$5M	74	\$2M	27	\$6M	93	\$19M	210
Total	\$27M	147	\$13M	242	\$8M	62	\$10M	147	\$58M	598

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Rhode Island also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Rhode Island Hospital in Providence (\$9 million), Miriam Hospital in Providence (\$6 million), Memorial Hospital in Pawtucket (\$3 million), Emma Pendleton Bradley Hospital in Providence (\$2 million), and the Rhode Island State Department of Health (\$2 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Rhode Island received eight SBIR awards totaling close to \$1 million. Examples include a \$100,000 award from the Air Force to Marine Acoustics, Inc., in Middletown for work on advanced analytic sonic boom underwater propagation analysis and a \$100,000 award from HHS to Psych Products Press in East Greenwich to develop a comprehensive outcome scale for outpatient psychiatry.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Rhode Island are ones valued at more than \$1.1 million from the Department of Agriculture (USDA's) Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from the Department of Interior's (DOI's) USGS to the Water Resources Research Institute in Rhode Island every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN RHODE ISLAND

Several entities in Rhode Island also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to Textron, Inc., which in FY 1998 received close to \$12 million from DOD (Army) primarily for work on the XM93 Wide Area Munition (WAM) Program. Most of this work, however, is actually performed by Textron Systems Division in Wilmington, Massachusetts. In addition, the Raytheon Company (\$10 million), Memorial Hospital (\$5 million), and the Rhode Island State Department of Health (\$2 million) received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Memorial Hospital and the State Department of Health. Brown University (\$2 million) and URI (\$500,000) also receive contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$4 million of federal R&D dollars was also received in FY 1998 by entities located in Rhode Island in the form of cooperative agreements. The largest of these cooperative agreements (\$1 million in FY 1998) came from NSF to Brown University to operate one of NSF's Materials Research Science and Engineering Centers—the Center for Advanced Materials Research. Other federal agencies awarding cooperative agreements to Rhode Island-based entities include DOC and DOD.

Chapter 42

Federal Research and Development in South Carolina

- Approximately \$205 million of federal R&D funds are spent each year in South Carolina.
- South Carolina ranks 38th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 2 percent of all federal funds spent in South Carolina each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

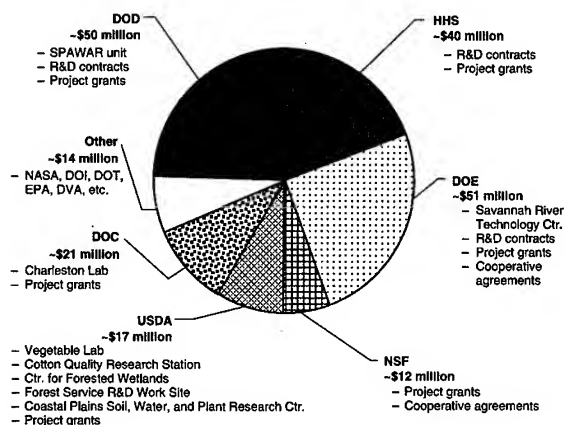


Figure 42.1 – Sources of Federal R&D Dollars Spent in South Carolina
(Total Federal R&D ~\$205 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$205 million annually in South Carolina on research and development (R&D) activities. On average, federal R&D dollars account for approximately 2 percent of all federal funds spent in South Carolina each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in South Carolina. Foremost among these agencies are the Departments of Energy (DOE), Defense (DOD), Health and Human Services (HHS), and Commerce (DOC), which account for 25, 24, 19, and 10 percent of all federal R&D dollars spent in the state, respectively. The Department of Agriculture (USDA) and the National Science Foundation (NSF) account for an additional 8 and 6 percent of all federal R&D dollars spent in South Carolina, respectively. The remaining federal R&D dollars come collectively from National Aeronautics and Space Administration (NASA), the Department of Interior (DOI), and several other federal agencies.⁴²

All federal R&D dollars spent in South Carolina either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in South Carolina.

FEDERAL R&D UNITS IN SOUTH CAROLINA

Aiken, South Carolina, is home to DOE's Savannah River Technology Center.

- The Savannah River Technology Center is a federally funded research and development center (FFRDC) sponsored by DOE and operated by Westinghouse. The center is the applied R&D

⁴² For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

laboratory for the Savannah River Site, which is also owned by DOE and operated by Westinghouse Savannah River Company, LLC, and produced tritium for nuclear weapons during the Cold War. The center now focuses on developing, testing, and demonstrating equipment and techniques for processing nuclear materials; cleaning up and protecting the environment; processing and stabilizing hazardous and radioactive waste materials; decontamination and decommissioning; and minimizing the danger globally from nuclear proliferation. Specific R&D activities focus on such areas as instrumentation, data acquisition, remote handling, robotics, modeling, experimental thermal-fluids analysis, and material packaging and transportation. Together with the Savannah River Site, this federally owned and contractor-operated center annually receives approximately \$1.3 billion of core funding and conducts an estimated \$49 million of specific R&D projects. While the overall Savannah River site has about 16,000 employees, the FFRDC has about 500 employees. A portion of the center's funds is spent on the maintenance and operation of R&D equipment and facilities.

Charleston, South Carolina, is home to DOD's Space and Naval Warfare Systems Center Charleston, USDA's U.S. Vegetable Laboratory and Center for Forested Wetlands, DOC's Charleston Laboratory, and a Department of Veterans Affairs (DVA) R&D unit.

- The Space and Naval Warfare Systems Center Charleston is a unit of DOD. It is a part of SPAWAR Command, located in San Diego, California, and also has a West Coast counterpart unit in San Diego. This center conducts R&D in the areas of command, control, communications, intelligence, surveillance, reconnaissance, and navigation. Specific R&D activities of this unit focus on sensors, image processing, air traffic control and environmental effects, navigation, computer security, briefing systems, and multifaceted communication pipelines. This federal unit annually receives about \$19.5 million of federal R&D funds, approximately \$8.5 million of which are for in-house activities, and has about 1,442 civilian personnel, only a portion of

whom are directly involved in R&D activities. Virtually all of these R&D funds are provided to the center on a reimbursable basis to cover the costs of work being done for a variety of units located throughout DOD and are therefore already reflected in amounts contained elsewhere in this report.

- The U.S. Vegetable Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of Clemson University. It conducts research to solve national problems in vegetable crop production and protection with emphasis on the southeastern United States. Specific research activities of this laboratory include studies to improve genetic populations of vegetable crops by combining resistance to diseases and pests (insects, nematodes, and weeds) with favored quality and new product characters, and studies on disease and pest biology that can be used as a basis for the development and implementation of new management systems that rely on host resistance rather than conventional pesticides. This federal R&D unit annually receives approximately \$2.6 million of federal R&D dollars and has about 33 FTEs.
- The Center for Forested Wetlands is a unit of the Southern Research Station inside USDA's Forest Service. It is on the Charleston campus of Clemson University. The center conducts research to develop, quantify, and synthesize ecological information needed to sustainably manage and restore the structure, functions, and productivity of forested wetland ecosystems through research and technology transfer in the areas of ecology, management, restoration, and landscape level modeling and assessments. Specific research activities of this center include ecological research, hydrology and water quality, landscape modeling and assessment, the Santee Experimental Forest, short rotation woody-crop production, silvicultural research, soil processes, wetland restoration, and wildlife habitat research. This federal R&D unit annually receives approximately \$1.1 million of federal R&D funds and has about 25 employees.
- The Charleston Laboratory and the research ship *Ferrel* are units of DOC's National Oceanic and Atmospheric Adminis-

tration (NOAA). The laboratory includes the Center for Coastal Environmental Health and Biomolecular Research, which works closely with the portion of the Beaufort/Oxford Laboratory in Oxford, Maryland. The center conducts research on coastal ecosystems' health, environmental quality, and related public health matters. In particular, it employs chemical, biomolecular, microbiological, and histological methods in both laboratory and field settings to describe, evaluate, and predict the controlling factors and outcomes of natural and anthropogenic influences in marine and estuarine habitats. The *Ferrel* collects coastal assessment data and monitors pollution to document the effects of human activities on the coastal and estuarine environments along the U.S. shoreline. Specific research activities of this unit focus on such matters as sampling water, conducting geologic surveys, taking bottom cores, surveying sediment quality, studying benthic macro invertebrates, conducting bathymetric surveys to study wave propagation, and conducting side scan sonar surveys to determine the biomass and bottom topography of several national marine sanctuaries. This federal unit annually receives approximately \$5.5 million of federal R&D dollars and has about 65 FTEs.

- While the principal focus of the Ralph H. Johnson VA Medical Center in Charleston is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 168 projects with total funding of approximately \$2 million. These R&D activities focus on a wide range of topics, including diabetes, lipid disorders, heart disease, hematology, fetal alcohol syndrome, kidney disease, and rheumatology.

Clemson, South Carolina, is home to the Department of Interior's (DOI's) South Carolina Cooperative Fish and Wildlife Research Unit and USDA's Cotton Quality Research Station and Forest Service R&D Work Site.

- The South Carolina Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It was es-

established on the campus of Clemson University in 1998. It conducts research on management of natural resources. Specific research activities of this unit include developing quantitative techniques for the analysis of animal habitat selection, evaluating the effect of slow growth on the otolith size–fish size relationship in striped bass, and analyzing environmental assessment program data from the Carolinian provinces. Other research activities involve studying endangered species biology, examining avian biology, and conducting ecological analysis. This federal R&D unit annually receives approximately \$203,000 of federal R&D funds and has about three FTEs.

- The Cotton Quality Research Station is a unit of USDA's ARS located on the campus of Clemson University. It conducts research on the different varieties and growths of cotton. Specific research activities of this station include the development of instruments for the objective measurement of the quality of cotton for marketing and utilization purposes, and measurement of the effects of cotton contaminants on the environmental safety and health of workers. This federal R&D unit annually receives approximately \$1.8 million of federal R&D funds and has about 27 FTEs.
- The R&D Work Site at the Department of Forest Resources at Clemson University is a unit of the Southern Research Station inside USDA's Forest Service. It conducts research on habitat and population relationships of wildlife and plant species associated with fragmented and isolated forest communities. Specific research activities of this unit include determining how the red-cockaded woodpecker populations respond to habitat manipulation and the amount and distribution of habitat required to support a viable population and identifying the habitat requirements of Threatened and Endangered Species (TES). Other activities focus on determining how the longleaf pine–wiregrass communities respond to habitat perturbations, identifying the habitat requirements and responses to habitat alterations of neotropical migratory birds, developing models for projecting the viability of populations of TES species, and learning the

habitat requirements and life history characteristics of the endangered northern flying squirrel in the southern Appalachians. This federal R&D unit annually receives approximately \$780,000 of federal R&D funds and has about eight employees.

Columbia, South Carolina, is home to DOI's South Carolina District Office of Water Resources and a DVA R&D unit.

- The South Carolina District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.7 million in federal R&D funds.
- While the principal focus of the William Jennings Bryan Dorn Veterans Hospital, the VA Medical Center in Columbia, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 72 projects with total funding of approximately \$700,000. These R&D activities focus on a wide range of topics, including hypertension, helicobacter pylori, congestive heart failure, and cerebrovascular disorders.

Florence, South Carolina, is home to USDA's Coastal Plains Soil, Water, and Plant Research Center.

- The Coastal Plains Soil, Water, and Plant Research Center is a unit of USDA's ARS located on the Florence campus of Clemson University. It conducts both basic and applied research on soil, water, and plant management. Specific research activities of this center include studies on soil erosion, strength and fertility, improving cotton germplasm, and increasing both sustainability and competitiveness of crop production. This federal R&D unit annually receives approximately \$2.2 million of federal R&D funds and has about 26 FTEs.

FEDERAL R&D GRANTS TO SOUTH CAROLINA ENTITIES

Every major institution of higher education in South Carolina is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, DOD, NSF, and DOE to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of South Carolina (U of SC), the Medical University of South Carolina (MUSC), Clemson University, and South Carolina State University (SCSU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, DOD, NSF, and DOE to parties at these institutions and estimates of the total dollars transferred

Table 42.1 – Sources of Federal R&D Grants to Higher Education in South Carolina

Institution	HHS		DOD		NSF		DOE		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
MUSC	\$33M	163	\$10M	5	\$1M	11	\$7M	4	<\$1M	7	\$52M	190
U of SC	\$10M	58	\$3M	14	\$7M	103	0	0	\$2M	22	\$22M	197
Clemson	\$1M	7	\$4M	16	\$3M	62	<\$1M	6	\$6M	220	\$13M	311
SCSU	<\$1M	1	<\$1M	1	<\$1M	1	\$2M	16	\$1M	19	\$3M	38
Other	\$1M	6	<\$1M	1	\$1M	15	<\$1M	1	\$1M	15	\$3M	38
Total	\$45M	235	\$17M	37	\$13M	192	\$9M	27	\$10M	283	\$93M	774

to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to Clemson University include \$4 million from USDA and \$1 million each from NASA and EPA. Most of the comparable grants going to the University of South Carolina are from EPA.

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in South Carolina also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the South Carolina Sea Grant Consortium in Charleston (\$3 million), the South Carolina State Department of Health and Environmental Control (DHEC) in Columbia (\$2 million), Blue Cross of South Carolina in Columbia (\$1 million), and the South Carolina Research Authority (SCRA) in Columbia (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in South Carolina received ten SBIR awards totaling close to \$1 million. Examples include a \$400,000 award from NSF to Poly-Med, Inc., in Anderson for work on surface-modified, ultrahigh-strength polyethylene fibers and a \$200,000 award from USDA to Southland Fisheries Corp. in Hopkins to study the indoor production of hybrid striped bass fingerlings.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting South Carolina are ones valued at more than \$4.9 million from USDA's Cooperative State Research, Education, and Exten-

sion Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in South Carolina every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN SOUTH CAROLINA

Several entities in South Carolina also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to SCRA, which in FY 1998 received close to \$7 million from DOD to support such efforts as the Navy's National Shipbuilding Research Program. In addition, Fuentez Systems Concepts, Inc. (\$3 million), DHEC (\$2 million), and Radiological Assessments Corp. (\$1 million) received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by SCRA and DHEC. The University of South Carolina (\$3 million) and Clemson University (\$2 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$24 million of federal R&D dollars was also received in FY 1998 by entities located in South Carolina in the form of cooperative agreements. The largest of these cooperative agreements (\$4 million in FY 1998) came from DOE to the South Carolina Institute for Energy Studies (SCIES) at Clemson University for work on the Advanced Gas Turbine Systems Research Program. Other federal agencies awarding cooperative agreements to South Carolina-based entities include DOC and NSF.

Chapter 43

Federal Research and Development in South Dakota

- Approximately \$39 million of federal R&D funds are spent each year in South Dakota.
- South Dakota ranks 52nd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 2 percent of all federal funds spent in South Dakota each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

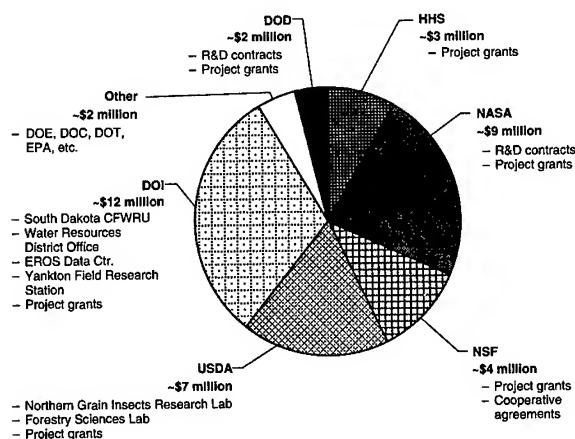


Figure 43.1 – Sources of Federal R&D Dollars Spent in South Dakota
(Total Federal R&D ~\$39 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$39 million annually in South Dakota on research and development (R&D) activities. On average, federal R&D dollars account for approximately 2 percent of all federal funds spent in South Dakota each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in South Dakota. Foremost among these agencies are the Department of Interior (DOI), the National Aeronautics and Space Administration (NASA), and the Department of Agriculture (USDA), which account for 31, 23, and 18 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF) and the Department of Health and Human Services (HHS) account for an additional 11 and 8 percent of all federal R&D dollars spent in South Dakota, respectively. The remaining federal R&D dollars come collectively the Departments of Transportation (DOT) and Commerce (DOC) and several other federal agencies.⁴³

All federal R&D dollars spent in South Dakota either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in South Dakota.

FEDERAL R&D UNITS IN SOUTH DAKOTA

Brookings, South Dakota, is home to DOI's South Dakota Cooperative Fish and Wildlife Research Unit and USDA's Northern Grain Insects Research Laboratory.

- The South Dakota Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the cam-

⁴³ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

pus of South Dakota State University. It conducts research on the interaction between wildlife and agriculture. Specific research activities of this unit include studying the ecosystem of the Great Plains. This federal R&D unit annually receives approximately \$193,000 of federal R&D funds and has about two FTEs.

- The Northern Grain Insects Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of South Dakota State University. It conducts research on sustainable production systems that enhance environmental quality. Specific research activities focus on crop and pest management. This federal R&D unit annually receives approximately \$3.3 million in federal R&D dollars and has about 26 employees.

Rapid City, South Dakota, is home to USDA's Forestry Sciences Laboratory and DOI's South Dakota District Office of Water Resources.

- The Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on the management and sustainability of ecological systems. Specific research activities of this lab include studying the structure and function of plant and animal populations, communities, and landscape ecological systems. This federal R&D unit annually receives approximately \$714,000 in federal R&D funds and has about six employees.
- The South Dakota District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of

these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.6 million in federal R&D funds.

Sioux Falls, South Dakota, is home to DOI's Earth Resources Observation Systems Data Center and Yankton Field Research Station.

- The Earth Resources Observation Systems (EROS) Data Center is a unit of DOI's USGS. It is a data management, systems development, and research field center. Its Research and Applications Division conducts research to understand the natural and anthropogenic processes that influence the Earth's surface. Specific research activities in this division encompass topographic studies that address the assembly, distribution, and application of framework elevation data for the United States and the development of terrain-based global hydrologic data bases; Arctic studies in the Alaska field office that promote research and applications of Geographical Information Service (GIS) and remote sensing technology; technique; and development research projects that explore new technologies and procedures in the development of new products and services, using remotely sensed data, among others. This federal R&D unit annually receives approximately \$5.6 million in federal R&D funds and has about 82 FTEs, only about four of whom conduct R&D.
- The Yankton Field Research Station is a unit of the Columbia Environmental Research Center inside DOI's USGS. It conducts research on surface mining, irrigation drain water, and agricultural activities to observe their effects on natural resources, such as the wetlands associated with the prairie pothole region in the upper Midwest and plains states, endangered fish species in the Colorado basin, and forested aquatic habitats. Specific re-

search activities of this unit include assessing the effects of substances on reproduction of endangered fish as part of the Recovery Implementation Program for the Endangered Fishes of the Upper Colorado River and for the San Juan River (New Mexico) Program. This federal R&D unit annually receives approximately \$171,000 of federal R&D funds and has about five FTEs.

FEDERAL R&D GRANTS TO SOUTH DAKOTA ENTITIES

Every major institution of higher education in South Dakota is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by USDA, NSF, NASA, and HHS to individual faculty members and therefore ultimately inure to the benefit of such institutions as South Dakota State University (SDSU), South Dakota School of Mines and Technology (SDSM&T), and the University of South Dakota (U of SD). The table below shows the number of R&D grants active in FY 1998, highlighting those made by USDA, NSF, NASA, and HHS to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category going to SDSU come from DOD and the Environmental Protection Agency.

Table 43.1 – Sources of Federal R&D Grants to Higher Education in South Dakota

Institution	USDA		NSF		NASA		HHS		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
SDSU	\$3M	142	<\$1M	5	<\$1M	3	<\$1M	1	\$1M	6	\$4M	157
SDSM&T	0	0	\$1M	16	\$1M	9	0	0	<\$1M	1	\$2M	26
U of SD	<\$1M	1	\$1M	6	0	0	\$1M	15	<\$1M	1	\$2M	23
Other	<\$1M	2	<\$1M	6	<\$1M	3	0	0	0	0	<\$1M	11
Total	\$3M	145	\$2M	33	\$1M	15	\$1M	16	\$1M	8	\$9M	217

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Other nonacademic institutions in South Dakota also receive a significant amount of federal R&D grants each year. Foremost among these institutions in South Dakota that received R&D grants in FY 1998 are the Siouxland Heritage Museums in Sioux Falls (\$1.5 million) and the Tribal Chairmen's Health Board in Aberdeen (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in South Dakota received eight SBIR awards totaling \$1 million. Examples include a \$200,000 award from USDA to Microconversion Technologies Co. in Brookings to study electronic environmental monitoring and a \$100,000 award from HHS to Visualmetrics Corp. in Vermillion to develop a high-efficiency genome informatics data system.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting South Dakota are ones valued at more than \$2.4 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in South Dakota every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN SOUTH DAKOTA

Several entities in South Dakota also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of the funds go to MSE Technology Applications, Inc., which in FY 1998 received close to \$130,000 in R&D contracts from DOD (Navy). In addition, Re/Spec, Inc. (\$100,000), and Two Way Service & Engineering (\$90,000) received R&D contracts from federal agencies in FY 1998.

A total of \$2 million of federal R&D dollars was also received in FY 1998 by entities located in South Dakota in the form of cooperative agreements. By far the largest of these cooperative agreements (\$1 million in FY 1998) came from NSF to SDSU to fund EPSCoR (Experimental Program to Stimulate Competitive Research) activities. Other federal agencies awarding cooperative agreements to South Dakota-based entities include USDA.

Chapter 44

Federal Research and Development in Tennessee

- Approximately \$708 million of federal R&D funds are spent each year in Tennessee.
- Tennessee ranks 23rd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 5 percent of all federal funds spent in Tennessee each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

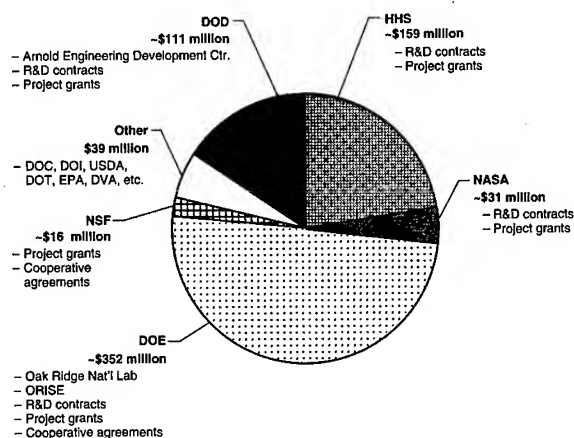


Figure 44.1 – Sources of Federal R&D Dollars Spent in Tennessee
(Total Federal R&D ~\$708 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$708 million annually in Tennessee on research and development (R&D) activities. On average, federal R&D dollars account for approximately 5 percent of all federal funds spent in Tennessee each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Tennessee. Foremost among these agencies is the Department of Energy (DOE), which accounts for 50 percent of all federal R&D dollars spent in the state. The Departments of Health and Human Services (HHS) and Defense (DOD) and the National Aeronautics and Space Administration (NASA) account for an additional 22, 16, and 4 percent of the federal R&D dollars spent in Tennessee, respectively. The remaining federal R&D dollars come collectively from the National Science Foundation (NSF), the Department of Agriculture (USDA), and several other federal agencies.⁴⁴

All federal R&D dollars spent in Tennessee either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Tennessee.

FEDERAL R&D UNITS IN TENNESSEE

Arnold Air Force Base, Tennessee, is home to DOD's Arnold Engineering Development Center.

- The Arnold Engineering Development Center at Arnold Air Force Base is a unit of DOD. It is a national aerospace ground test center that conducts development, certification, and simulated flight testing in support of DOD, commercial and inter-

⁴⁴ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

national propulsion, aerodynamic, reentry, transatmospheric, and space-flight systems. Testing is performed in an environment that simulates operational conditions. Additionally, the center conducts research to develop new test capabilities, facilities, and technologies for future simulated flight-testing. The center also has a hypervelocity wind tunnel test facility in White Oak, Maryland. This federal unit annually receives approximately \$291 million of federal R&D dollars, approximately \$267 million of which is spent on in-house activities, and has about 204 civilian personnel.

Cookeville, Tennessee, is home to the Department of Interior's (DOI's) Tennessee Cooperative Fishery Research Unit.

- The Tennessee Cooperative Fishery Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the campus of Tennessee Technological University. It conducts research on freshwater fish and mussel communities, including numerous endangered species, in numerous impoundments ranging from coldwater, oligotrophic systems to warmwater, eutrophic systems. In addition, its dams also supports cool- and coldwater tailwater fisheries. Specific research activities of this unit include studies of mussels, Normandy reservoir research, statewide crappie evaluation, hooking mortality of saugers, tailwater trout, and Duck River creel survey. This federal R&D unit annually receives approximately \$77,000 of federal R&D funds and has about two FTEs.

Gatlinburg, Tennessee, is home to DOI's Great Smokey Mountains Field Station.

- The Great Smokey Mountains Field Station is a unit of the Leetown Science Center inside DOI's USGS. It is a field station of the Southern Appalachian Field Laboratory in Knoxville. It conducts research on water resources and watersheds and the effects of human disturbance on wildlife. This federal R&D unit annually receives approximately \$268,000 of federal R&D funds and has one FTE.

Johnson City, Tennessee, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Mountain Home VA Medical Center in Johnson City is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 116 projects with total funding of approximately \$350,000. These R&D activities focus on a wide range of topics, including bone density, drug therapy, colonic neoplasms, and adjuvant chemotherapy.

Knoxville, Tennessee, is home to DOI's Southern Appalachian Field Laboratory.

- The Southern Appalachian Field Laboratory is a unit of the Leetown Science Center inside DOI's USGS. It conducts research on resource management, with an emphasis on entire ecosystems. Specific research activities include studying water resources and watersheds in upland ecosystems of the Southeast; modeling landscape using GIS to predict and mitigate the effects of human disturbance on wildlife; and developing protocols to inventory and monitor natural and human resources in upland ecosystems in the Southeast. This federal R&D unit annually receives approximately \$121,000 of federal R&D funds and has about three FTEs.

Memphis, Tennessee, is home to a DVA R&D unit.

- While the principal focus of the Memphis VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 201 projects with total funding of approximately \$2 million. These R&D activities focus on a wide range of topics, including arthritis, hypertension, diabetes, autoimmune diseases, and neoplasms.

Nashville, Tennessee, is home to DOI's Tennessee District Office of Water Resources and a DVA R&D unit.

- The Tennessee District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.7 million in federal R&D funds.
- While the principal focus of the Nashville VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 331 projects with total funding of approximately \$6 million. These R&D activities focus on a wide range of topics, including neoplasms, transplantation, growth substances, diabetes, and wound healing.

Oak Ridge, Tennessee, is home to DOE's Oak Ridge National Laboratory and Oak Ridge Institute for Science and Education.

- The Oak Ridge National Laboratory is a federally funded research and development center (FFRDC) sponsored by DOE and operated by Lockheed Martin Energy Research Corporation. It conducts R&D activities that concentrate on increasing the availability of clean, abundant energy; restoring and protecting the environment; and contributing to national security.

The laboratory also performs other work for DOE, including isotope production, information management, and technical program management, and provides research and technical assistance to other organizations. Specific R&D activities focus on such areas as magnetic fusion, high-energy physics, nuclear physics, basic energy sciences, computational technology, biology, the environment, and energy resources. This federally owned and contractor-operated laboratory annually receives approximately \$410 million of core funding and conducts an estimated \$388 million of specific R&D projects. The laboratory has about 5,000 employees. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Oak Ridge Institute for Science and Education is sponsored by DOE and operated by Oak Ridge Associated Universities, Inc. In 1999, DOE changed the status of the institute from an FFRDC to an ordinary contractor-operated facility. The institute studies the research on energy and related fields conducted by educational institutions in the United States, particularly those in the southeastern region. It also conducts studies on health protection and biomedical and environmental research activities in such areas as radiation accident management and training, biochemistry and immunology, radiation biology, toxicology, human reliability, and industrial medicine. The institute also arranges, coordinates, and manages cooperative research programs jointly funded by DOE and universities or industry to provide opportunities for university faculty, students, and industrial researchers to conduct research at DOE's R&D facilities. This federally owned and contractor-operated institute annually receives approximately \$35 million of core funding, most of which is spent on extramural activities, and conducts an estimated \$3.7 million of specific R&D projects. The institute has about 35 employees.

FEDERAL R&D GRANTS TO TENNESSEE ENTITIES

Every major institution of higher education in Tennessee is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, USDA, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Tennessee, Vanderbilt University, Meharry Medical College, Tennessee State University (TSU), and the University of Memphis (U of Memphis). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, USDA, and DOD to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Tennessee are ones from DOE (\$4 million), with most of the remainder coming from EPA, Department of Transportation, and NASA. The comparable grants going to Vanderbilt University include \$2 million from DOE and \$1 million from NASA.

Table 44.1 – Sources of Federal R&D Grants to Higher Education in Tennessee

Institution	HHS		NSF		USDA		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Tennessee	\$29M	166	\$7M	121	\$5M	161	\$2M	18	\$5M	59	\$48M	525
Vanderbilt	\$3M	13	\$5M	88	<\$1M	3	\$5M	16	\$4M	49	\$16M	169
Meharry	\$8M	52	<\$1M	1	0	0	0	0	<\$1M	1	\$8M	54
TSU	\$2M	6	<\$1M	2	\$2M	14	\$1M	4	<\$1M	10	\$5M	36
U of Memphis	\$4M	29	\$1M	20	<\$1M	1	<\$1M	6	<\$1M	11	\$5M	67
Other	\$4M	29	\$1M	14	<\$1M	4	0	0	\$1M	33	\$6M	80
Total	\$49M	295	\$13M	246	\$7M	183	\$7M	44	\$11M	163	\$88M	931

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each

year to various academic departments within these institutions, such as the Center for Health Sciences at the University of Tennessee.

Several other nonacademic institutions in Tennessee also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are Vanderbilt University Hospital in Nashville (\$95 million), St. Jude Children's Research Hospital in Memphis (\$27 million), and Connecticut General Life Insurance Co. in Nashville (\$3 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Tennessee received 39 SBIR awards totaling close to \$9 million. Examples include a \$500,000 award from the Air Force to Accurate Automation Corp. in Chattanooga for work on advanced neurocontrol methods for a remotely piloted vehicle, and a \$750,000 award from HHS to Medical Services Research Group in Memphis to develop a public health data management system.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Tennessee are ones valued at more than \$6.6 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Tennessee every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN TENNESSEE

Several entities in Tennessee also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go to Sverdrup Technology, Inc., which in FY 1998 received close to \$139 million, primarily for operation, maintenance, and repair of the test facilities at DOD's Arnold Engineering Development Center at Arnold Air Force Base. In addition, Micro Craft, Inc. (\$17 million), Eberline Analytical Corp. (\$2 million), Accurate Automation Corp. (\$2 million), and the Boeing Company (\$2 million) received large R&D contracts from federal agencies in FY 1998. The University of Tennessee (\$9 million) and Vanderbilt University (\$2 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$12 million of federal R&D dollars was also received in FY 1998 by entities located in Tennessee in the form of cooperative agreements. The largest of these cooperative agreements (\$3.5 million in FY 1998) came from DOE to the Oak Ridge Operations Office for work on the Automotive Lightweight Materials Program. Other federal agencies awarding cooperative agreements to Tennessee-based entities include NSF and the Department of Interior.

Chapter 45

Federal Research and Development in Texas

- Approximately \$4.0 billion of federal R&D funds are spent each year in Texas.
- Texas ranks 5th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 10 percent of all federal funds spent in Texas each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

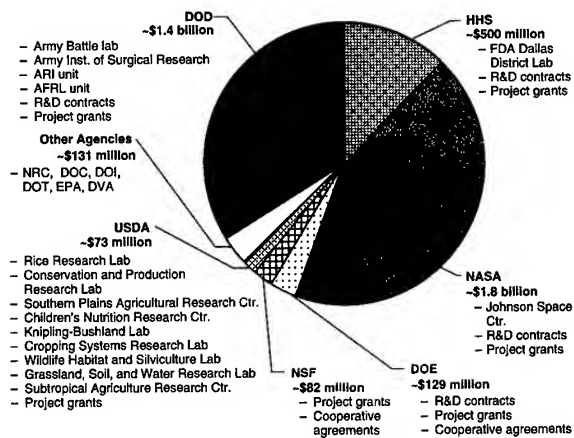


Figure 45.1 – Sources of Federal R&D Dollars Spent in Texas
(Total Federal R&D ~\$4.0 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$4.0 billion annually in Texas on research and development (R&D) activities. On average, federal R&D dollars account for approximately 10 percent of all federal funds spent in Texas each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Texas. Foremost among these agencies are the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD), which account for 44 percent and 34 percent of all federal R&D dollars spent in the state, respectively. The Department of Health and Human Services (HHS) accounts for an additional 12 percent of the federal R&D dollars spent in Texas. The remaining federal R&D dollars come collectively from the National Science Foundation (NSF); the Departments of Agriculture (USDA), Commerce (DOC), Energy (DOE), and Veterans Affairs (DVA); and several other federal agencies.⁴⁵

All federal R&D dollars spent in Texas either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Texas.

FEDERAL R&D UNITS IN TEXAS

Austin, Texas, is home to the Department of Interior's (DOI's) Texas District Office of Water Resources.

- The Texas District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hy-

⁴⁵ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

drology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$3 million in federal R&D funds.

Beaumont, Texas, is home to USDA's Rice Research Laboratory.

- The Rice Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the Beaumont campus of Texas A&M. It conducts research on breeding methodology, grain quality characteristics, host-parasite disease reactions, and the mechanisms of virulence of pathogenic agents against rice field pests. Specific research activities of this lab include identifying, adapting, and evaluating new breeding methods, such as biotechnology, for use in varietal improvement programs. This federal R&D unit annually receives approximately \$1.2 million of federal R&D funds and has about 14 FTEs.

Bushland, Texas, is home to USDA's Conservation and Production Research Laboratory.

- The Conservation and Production Research Laboratory is a unit of USDA's ARS. It is composed of two research divisions focusing on energy, soil, and animal waste resources and water management. The laboratory conducts research on developing improved water irrigation technology for sustaining and en-

hancing crop productivity, improving the efficient use of water, reducing the use of groundwater, and enhancing the overall quality of water and soil. Specific research activities include developing systems for utilizing renewable energy sources (i.e., wind, solar, and biofuels) for pumping irrigation, supporting livestock, and enhancing farmstead water, as well as generating electric power. This federal R&D unit annually receives approximately \$2.3 million of federal R&D funds and has about 34 FTEs.

College Station, Texas, is home to USDA's Southern Plains Agricultural Research Center and DOI's Brazos Field Research Station.

- The Southern Plains Agricultural Research Center is a unit of USDA's ARS located on the campus of Texas A&M. It consists of two divisions—the Southern Crops Research Laboratory and the Food Animal Protection Research Laboratory. The first laboratory focuses on crop germplasm research, areawide pest management research, and cotton pathology research. Specific activities include studying the DNA characteristics of germplasm and genome mapping of germplasm; researching ways to decrease the risk and use of synthetic pesticides; and looking into disease and nematode resistance and identifying ecologically vulnerable points in the behavior and biology of nematodes. The second laboratory focuses on veterinary entomology research and food and feed safety research. Specific research activities include identifying and purifying of cytokines and monoclonal antibody-based rapid tests to aid the analysis of chemical residues in foods, animal products, and fluids; and characterizing the toxicologic effects of mycotoxins in poultry and livestock and developing methods of diminishing their toxic effects. This federal R&D unit annually receives approximately \$12.4 million of federal R&D funds and has about 146 FTEs.
- The Brazos Field Research Station is a unit of the Columbia Environmental Research Center inside DOI's USGS. It is on the campus of Texas A&M University. It conducts research on wildlife ecology and toxicology of terrestrial wildlife, particu-

larly birds, mammals, and reptiles. Specific research activities of this unit include investigating lethal and sublethal effects of environmental contaminants on animals. This federal R&D unit annually receives approximately \$203,000 of federal R&D funds and has about three FTEs.

Corpus Christi, Texas, is home to DOI's Padre Island Field Research Station and Corpus Christi Field Station.

- The Padre Island Field Research Station is a unit of the Columbia Environmental Research Center inside DOI's USGS. It conducts research to determine how human activities affect sea turtles in Texas and elsewhere in the United States. Specific research activities of this unit include collecting data on turtle nest distribution, size, relative abundance, and foraging ecology and using the information to protect, manage, and restore these endangered and threatened species. This federal R&D unit annually receives approximately \$59,000 of federal R&D funds and has about three FTEs.
- The Corpus Christi Field Station is a unit of the Columbia Environmental Research Center inside DOI's USGS. It consists of the Texas Gulf Coast Field Research Station and the Marine Ecotoxicology Research Station. The unit is on the campus of Texas A&M University, Corpus Christi. The activities of the first research station focus on the abundance and diversity of resident and migratory birds in south Texas. Specific research activities include studies of wintering grassland bird use of native and exotic grasses in Texas coastal prairies, habitat use and feeding ecology of migratory waterfowl in the Laguna Madre ecosystem, and status of avian communities of the lower Rio Grande Valley. The research activities of the second research station focus on assessing the impacts of contaminants on marine and estuarine organisms. Specific research activities of this station include developing and evaluating methods to assess the quality of estuarine sediments. This federal R&D unit annually receives approximately \$409,000 of federal R&D funds and has about seven FTEs.

Dallas, Texas, is home to HHS's Dallas District Laboratory and a DVA R&D unit.

- The Dallas District Laboratory is a unit of HHS's Food and Drug Administration. It conducts research on the safety and efficacy of human drugs. This federal unit annually receives approximately \$163,000 of federal R&D funds and has about two FTEs directly involved in R&D activities. This unit is scheduled to close in 2000.
- While the principal focus of the Dallas VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 293 projects with total funding of approximately \$2.2 million. These R&D activities focus on a wide range of topics, including echocardiography, coronary disease, psychotic disorders, and ultrasonography.

Fort Bliss, Texas, is home to a unit of DOD's Air and Missile Defense Battle Laboratory.

- The Air and Missile Defense Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. It conducts research on technologies that will identify, track, engage, and assess all airborne targets. Specific R&D activities of this laboratory focus on such matters as high-energy lasers, radar, microwaves, and advanced missile designs. This federal unit annually receives about \$880,000 of federal R&D funds, only a portion of which is spent in-house, and has no civilian personnel.

Fort Hood, Texas, is home to a unit of DOD's Army Research Institute.

- The Fort Hood Scientific Research Office is a unit of DOD's Army Research Institute for Behavioral and Social Sciences headquartered in Alexandria, Virginia. Additional sites are located in Fort Rucker, Alabama; Fort Benning, Georgia; Fort

Leavenworth, Kansas; Fort Knox, Kentucky; Fort Bragg, North Carolina; Orlando, Florida; Heidelberg, Germany; and Boise, Idaho. It disseminates institute research progress and products, makes known research opportunities at Fort Hood throughout the institute, and coordinates all institute research under the auspices of the Digital Force Coordination Cell. This federal unit annually receives approximately \$125,000 of federal R&D funds and has one civilian employee directly involved in R&D activities. This unit was closed in 1999.

Galveston, Texas, is home to DOC's Galveston Laboratory.

- The Galveston Laboratory is a unit of the Southeast Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). It conducts research on the conservation of endangered sea turtles, sea turtle biology, fishery ecology, seagrass and marsh restoration, Texas brown shrimp, and Tortugas pink shrimp. This federal unit annually receives approximately \$2.7 million of federal R&D funds and has about 46 FTEs, only a portion of whom are involved in R&D activities.

Houston, Texas, is home to NASA's Lyndon B. Johnson Space Center, USDA's Children's Nutrition Research Center, and a DVA R&D unit.

- The Lyndon B. Johnson Space Center is a unit of NASA. It conducts biomedical research and advanced studies involving human exploration beyond low-Earth orbit. Specifically, the center conducts R&D on spacecraft design, life sciences, and biomedical matters. Recent R&D projects have included developing the X-38 atmospheric vehicle, utilizing space technology to create human heart pumps, and growing human tissue cultures in space for use in cancer research. This federal facility annually receives a total of about \$4.3 billion, an estimated 70 percent of which directly involves R&D efforts. The center has about 3,147 FTEs, only a portion of whom are involved in R&D activities. Approximately \$40 million of the center's funds and 550 of its staff are located at the White Sands Test Facility in Las Cruces, New Mexico. A substantial portion of its

funds is spent on the maintenance and operation of R&D equipment and facilities. In a recent year, the center awarded over \$1.6 billion of R&D contracts, about \$1.5 billion of which were made to entities based in Texas.

- The Children's Nutrition Research Center is a unit of USDA's ARS located on the campus of Baylor University. It conducts research on the nutritional needs of children and pregnant and nursing women. Specific research activities of this center include an examination of the consequences of intakes of calcium and iron on growth and neurodevelopment and an exploration of the diet and genetic interactions in expression of mucosal hydrolases. This federal R&D unit annually receives approximately \$11 million of federal R&D funds and has about 10 FTEs.
- While the principal focus of the Houston VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 423 projects with total funding of approximately \$8.2 million. These R&D activities focus on a wide range of topics, including prostatic neoplasms, helicobacter pylori, congestive heart failure, HIV, and spinal cord injuries.

Kerrville, Texas, is home to USDA's Knippling-Bushland Laboratory.

- The Knippling-Bushland Laboratory is a unit of USDA's ARS. It is composed of two divisions focusing on biting fly and cattle grub research and tick research. The laboratory conducts research on the biology and the control of parasitic insects, ticks, and mites that affect livestock. Specific research activities of this laboratory include evaluating the efficacy of new chemicals, including the development of novel formulations and applications of these chemicals to make them more efficient and safer to use, and developing alternatives to current vaccines that make animals resistant to parasitic insects, ticks, and mites. This federal R&D unit annually receives approximately \$2.7 million of federal R&D funds and has about 43 FTEs.

Lubbock, Texas, is home to USDA's Cropping Systems Research Laboratory and DOI's Texas Cooperative Fish and Wildlife Research Unit.

- The Cropping Systems Research Laboratory is a unit of USDA's ARS located on the campus of Texas Tech. It is composed of three research divisions focusing on plant stress and germplasm development, cotton production and processing, and wind erosion and water conservation. Specific research activities include determining the causes of wind-induced soil erosion, developing mitigation strategies for droughts, developing management practices to reduce animal pathogen loads, and improving the processing and production systems for stripper-harvested cotton. This federal R&D unit annually receives approximately \$4 million of federal R&D funds and has about 60 FTEs.
- The Texas Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of Texas Tech University. It conducts fisheries research to develop techniques for propagation and management of fish and other aquatic species. Specific research activities of this unit include studying species with recreational or commercial value, as well as those that are rare or endangered, and fish farming. It also conducts research on behavioral ecology and conservation biology with wildlife ecology to aid in the development of nontraditional management strategies. Specific research activities focus on wildlife biology, behavioral ecology, genetics, animal behavior, and population biology. This federal R&D unit annually receives approximately \$197,000 of federal R&D funds and has about two FTEs.

Nacogdoches, Texas, is home to USDA's Wildlife Habitat and Silviculture Laboratory.

- The Wildlife Habitat and Silviculture Laboratory is a unit of the Southern Research Station inside USDA's Forest Service. The laboratory is on the campus of Stephen F. Austin State University. It conducts research to quantify relationships between

wildlife habitat values and forest management strategies and to incorporate findings into management planning. Specific research activities include investigating wildlife and habitat interactions involving both game and nongame species in addition to threatened and endangered species. This includes studying biodiversity and wildlife along streams, maintenance of viable populations of insectivorous birds (especially woodpeckers), and response of wildlife to various tree-harvesting techniques to improve overall forest health. This federal R&D unit annually receives approximately \$780,000 of federal R&D funds and has about 15 employees.

San Antonio, Texas, is home to DOD's Army Institute of Surgical Research and a portion of the Air Force Research Laboratory Human Effectiveness Directorate; the Nuclear Regulatory Commission's Center for Nuclear Waste Regulatory Analyses; and a DVA R&D unit.

- The Army Institute of Surgical Research at Fort Sam Houston is a unit of DOD. It conducts R&D on military trauma, with particular emphasis on the cellular mechanism and treatment of hemorrhagic shock and the treatment of burns. This federal unit annually receives approximately \$7 million of federal R&D funds, virtually all of which are spent on in-house activities, and has about 50 civilian personnel.
- The Human Effectiveness Directorate at Brooks Air Force Base is a unit of DOD's Air Force Research Laboratory. The directorate is headquartered in Dayton, Ohio, with an additional site in Mesa, Arizona. This unit conducts R&D in aerospace and weapons systems. Its recent R&D activities have included optical radiation, veterinary science, systems research, and flight motion effects. This federal unit annually receives approximately \$38 million of federal R&D funds, only about 25 percent of which is spent on in-house R&D activities, and has about 132 civilian personnel. A substantial portion of the directorate's funds is spent on the maintenance and operation of R&D equipment and facilities.

- The Center for Nuclear Waste Regulatory Analyses is a federally funded research and development center (FFRDC) sponsored by the Nuclear Regulatory Commission and operated by the Southwest Research Institute. The center's main research focus is resolving technical and regulatory issues related to a geologic repository for high-level nuclear waste. This federally owned and contractor-operated R&D unit annually receives approximately \$17 million of federal R&D funds and has about 72 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- While the principal focus of the South Texas Veterans Health Care System facility, the VA Medical Center in San Antonio, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 654 projects with total funding of approximately \$4.1 million. These R&D activities focus on a wide range of topics, including neoplasms, pharmacokinetics, antineoplastic agents, antifungal agents, and non-insulin-dependent diabetes mellitus.

Temple, Texas, is home to USDA's Grassland, Soil, and Water Research Laboratory.

- The Grassland, Soil, and Water Research Laboratory is a unit of USDA's ARS. It is composed of two divisions focusing on natural resources systems and grassland protection. The lab conducts research on the effects of global change on agriculture, crop production, soil fertility, erosion, hydrology, and water quality. Specific research activities of this lab include developing technology for maximizing forage and crop production and researching efficiency problems in the use of soil and water. This federal R&D unit annually receives approximately \$3.2 million of federal R&D funds and has about 43 FTEs.

Weslaco, Texas, is home to USDA's Subtropical Agriculture Research Center.

- The Subtropical Agriculture Research Center is a unit of USDA's ARS located on the Weslaco campus of Texas A&M. It is composed of three research divisions focusing on beneficial insects, crop quality and fruit insects, and integrated farming and natural resources. Specific research activities include studying crop pollination facilitation and crop pests management, examining crop protection chemicals and quarantine alternatives, and developing spatial information technologies for natural resource management. This federal R&D unit annually receives approximately \$8.6 million of federal R&D funds and has about 115 FTEs.

Amarillo and Temple, Texas, are home to VA medical facilities. While the principal focus of these facilities is providing medical care to veterans, each center is also the location of a number of research activities. In a recent year, these federally owned and operated facilities were the site of 75 R&D projects with total funding of less than \$400,000. These R&D activities focus on a wide range of topics, including schizophrenia, non-small-cell lung carcinoma, lung neoplasms, congestive heart failure, and Alzheimer's disease.

FEDERAL R&D GRANTS TO TEXAS ENTITIES

Every major institution of higher education in Texas is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Texas, Baylor College of Medicine, Texas A&M University, Rice University, the University of Houston, Texas Tech University, the University of North Texas (UNT), and Southern Methodist University (SMU). The table below shows the total number of R&D grants that were active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in

the "Other Agencies" category going to U of Texas are \$9 million each from DOE and NASA. The comparable grants going to Texas A&M include \$10 million from USDA, \$4 million from DOE, and \$2 million each from DOC and NASA. The grants in this category that are not associated with a specifically named institute include \$5 million from the Environmental Protection Agency (EPA) to Lamar University and a total of \$4 million of grants from USDA, DOE, and NASA to Prairie View A&M.

Table 45.1 – Sources of Federal R&D Grants to Higher Education in Texas

	HHS		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Texas	\$350M	1,572	\$28M	440	\$22M	95	\$22M	280	\$422M	2,387
Baylor College	\$115M	473	\$1M	14	<\$1M	1	\$3M	31	\$119M	519
Texas A&M	\$15M	119	\$8M	154	\$3M	32	\$20M	652	\$46M	957
Rice	\$5M	34	\$6M	125	\$2M	22	\$5M	68	\$19M	249
U of Houston	\$5M	40	\$5M	78	\$4M	10	\$3M	54	\$17M	182
Texas Tech	\$3M	37	\$1M	34	\$1M	6	\$2M	20	\$7M	97
UNT	\$4M	35	<\$1M	19	<\$1M	3	\$1M	17	\$5M	74
SMU	\$1M	9	\$2M	43	<\$1M	2	\$1M	7	\$4M	61
Other	\$6M	38	\$1M	30	\$1M	7	\$14M	94	\$22M	169
Total	\$505M	2,357	\$53M	937	\$34M	178	\$70M	1,223	\$661M	4,695

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the University of Texas Graduate School of Biomedical Sciences.

Several other nonacademic institutions in Texas also receive a significant number of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Southwest Foundation for Biomedical Research in San Antonio (\$12 million), the Cancer Therapy and Research Center in San Antonio (\$11 million),

and Texas Engineering Experiment Station in College Station (\$9 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Texas received 163 SBIR awards totaling \$40 million. Examples include a \$750,000 award from DOD (Army) to Lipitek International, Inc., in San Antonio for innovative design and synthesis of antiparasitic agents and a \$750,000 award from DOE to Lynntech, Inc., in College Station for work on a selective and cost-effective oxidant for the treatment of radioactive tank waste.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Texas are ones valued at more than \$9.1 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) going to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Texas every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN TEXAS

Several entities located in Texas also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far, the majority of these funds go to the Boeing Company for work on NASA's International Space Station (close to \$1.4 billion in FY 1998). In addition, Texas-based units of Raytheon and its subsidiaries (\$240 million), Texas Instruments (\$168 million), Bell Helicopter Textron (\$77 million), and Lockheed Martin

(\$39 million) received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by Texas Instruments and Lockheed Martin. The University of Texas (\$98 million), Baylor College of Medicine (\$8 million), and Texas A&M University (\$2 million) also received contracts in FY 1998 from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$24 million of federal R&D dollars in the form of cooperative agreements was also received in FY 1998 by entities located in Texas. The largest of these cooperative agreements (\$3 million) came from USDA to the Texas Animal Health Commission to support the Cooperative Brucellosis Eradication Program. Other federal agencies awarding cooperative agreements to Texas-based entities include NSF, DOE, and DOC. Among these latter cooperative agreements are awards supporting two of NSF's Science and Technology Centers—the Center for Synthesis, Growth, and Analysis of Electronic Materials at the University of Texas at Austin and the Center for Research on Parallel Computation at Rice University in Houston. In addition, Texas is home to one of NSF's Materials Research Science and Engineering Centers—the Center for Advanced Oxides and Related Materials at the University of Houston.

Chapter 46

Federal Research and Development in Utah

- Approximately \$377 million of federal R&D funds are spent each year in Utah.
- Utah ranks 28th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 9 percent of all federal funds spent in Utah each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

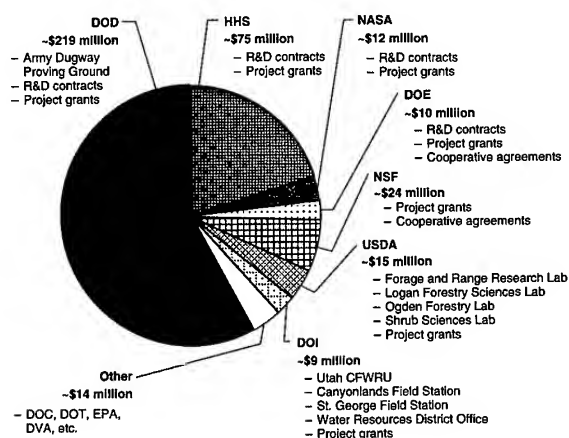


Figure 46.1 – Sources of Federal R&D Dollars Spent in Utah
(Total Federal R&D ~\$377 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$377 million annually in Utah on research and development (R&D) activities. On average, federal R&D dollars account for approximately 9 percent of all federal funds spent in Utah each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Utah. Foremost among these agencies are the Departments of Defense (DOD) and Health and Human Services (HHS), which account for 58 and 20 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF), the Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), and the Department of Energy (DOE) account for an additional 6, 4, 3, and 3 percent of the federal R&D dollars spent in Utah, respectively. The remaining federal R&D dollars come collectively from the Departments of Interior (DOI), Commerce (DOC), and Transportation (DOT) and several other federal agencies.⁴⁶

All federal R&D dollars spent in Utah either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Utah.

FEDERAL R&D UNITS IN UTAH

Dugway, Utah, is home to DOD's Dugway Proving Ground.

- The Dugway Proving Ground is a unit of DOD's U.S. Army Materiel Command Test and Evaluation Command. This facility is the site of field and laboratory tests evaluating the effectiveness of chemical weapons; chemical and biological defensive and

⁴⁶ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

protective systems; and smoke, obscurant, and illumination systems. Research includes the testing of chemical and biological survivability of defense materiel. This federal unit annually receives about \$40 million of federal R&D funds, approximately \$20 million of which are spent on in-house activities, and has about 437 personnel.

Logan, Utah, is home to USDA's Forage and Range Research Laboratory and Logan Forestry Sciences Laboratory and DOI's Utah Cooperative Fish and Wildlife Research Unit.

- The Forage and Range Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) on the Logan campus of Utah State University. The laboratory consists of three research divisions focusing on forage and range research, poisonous plant research, and pollinating insects. The research activities of this unit aim to broaden the genetic base of rangeland and pasture plants and develop methods for treating and reducing the effects of poisonous plant toxins in animals and humans. It also studies bee pollination. Specific research activities of this unit include identifying the molecular and quantitative genetics of grasses; studying the cytogenetics of forage and cereal germplasm; characterizing the pollination needs of threatened and endangered plants; and locoweed diagnostics, larkspur poisoning, pine needle abortive agents, and alkaloid analysis of other plant toxins. This federal R&D unit annually receives approximately \$4.7 million of federal R&D funds and has about 46 FTEs.
- The Logan Forestry Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on the restoration of ecosystems and insect ecology. Specific research activities of this lab include research into restoring vegetation and studying forest bark beetles to minimize infestation. This federal R&D unit annually receives approximately \$743,000 in federal R&D funds and has about 30 employees.
- The Utah Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the campus of

Utah State University. It conducts research on habitat requirements and ecology of fish, birds, and terrestrial wildlife. Specific research activities of this unit include the reintroduction of trumpeter swans to Utah; population and ecology of swift fox; aquatic habitat mapping; impact of introduction of lake trout; limnological effects of walleye production; and habitat selection of cavity nesting birds. This federal R&D unit annually receives approximately \$254,000 of federal R&D funds and has about three FTEs.

Moab, Utah, is home to DOI's Canyonlands Field Station.

- The Canyonlands Field Station is a unit of the Forest and Rangeland Ecosystem Science Center inside DOI's USGS. It conducts research to support management and conservation of forest and rangeland ecosystems in the Intermountain West. Generally, research topics of this unit include environmental physiology of fish and fish genetics, forest-wildlife relationships, wildlife population analysis, and environmental contaminants. Specific research activities of this unit include studies of desert soil ecology, invertebrates, and vascular plants. This federal R&D unit annually receives approximately \$291,000 of federal R&D funds and has about five FTEs.

Ogden, Utah, is home to USDA's Ogden Forestry Laboratory.

- The Ogden Forestry Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on forest management practices. Specific research activities of this laboratory include maintaining a comprehensive inventory of the status and trends of the use and health of forest ecosystems. This federal R&D unit annually receives approximately \$1.8 million in federal R&D funds and has 55 employees.

Provo, Utah, is home to USDA's Shrub Sciences Laboratory.

- The Shrub Sciences Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on shrubland biology and restoration. Specific research

activities of this lab include developing improved shrubs and production technology and management techniques to rehabilitate and improve wildlife habitats, rangelands, and disturbed lands in the intermountain west. This federal R&D unit annually receives approximately \$882,000 in federal R&D funds and has about 12 employees.

Saint George, Utah, is home to DOI's St. George Field Station.

- The St. George Field Station is a unit of the Western Ecological Research Center inside DOI's USGS. It conducts research on the plants and animals that live at the geographic and physiological limits of the ecotone between the Mojave, Great Basin, and Sonoran Deserts and are challenged by rapid urban growth. Specific research activities include studying the translocation, reproduction, density estimation, and monitoring of the desert tortoise; the effect of fire and invasive plants on Sonoran and Mojave Desert ecosystems; and the effect of increased atmospheric carbon dioxide on Mojave Desert vegetation. This federal R&D unit annually receives approximately \$244,000 of federal R&D funds and has about five FTEs.

Salt Lake City, Utah, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the VA Salt Lake City health care system facility, the VA Medical Center in Salt Lake City, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 268 projects with total funding of approximately \$3 million. These R&D activities focus on a wide range of topics, including geriatrics, arthritis, pacemakers, and heart transplantation.

West Valley City, Utah, is home to DOI's Utah District Office of Water Resources.

- The Utah District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources As-

assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.5 million in federal R&D funds.

FEDERAL R&D GRANTS TO UTAH ENTITIES

Every major institution of higher education in Utah is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Utah, Utah State University (USU), and Brigham Young University (BYU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties at these institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category going to the University of Utah are from DOE (\$2 million). The comparable grants going to USU include \$3 million from USDA and \$2 million from NASA.

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these

Table 46.1 – Sources of Federal R&D Grants to Higher Education in Utah

	HHS		NSF		DOD		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Utah	\$71M	350	\$13M	185	\$3M	24	\$3M	78	\$90M	637
USU	\$2M	15	\$4M	67	\$1M	8	\$6M	179	\$14M	269
BYU	\$1M	14	\$2M	34	<\$1M	4	\$1M	12	\$4M	64
Other	<\$1M	1	<\$1M	2	\$1M	2	<\$1M	1	\$1M	6
Total	\$75M	380	\$19M	288	\$5M	38	\$11M	270	\$110M	976

funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the School of Medicine at the University of Utah.

Several other nonacademic institutions in Utah also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are LDS Hospital in Salt Lake City (\$1 million), Cimarron Software, Inc., in Salt Lake City (\$1 million), and Materials & Systems Research in Salt Lake City (\$500,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Utah received 43 SBIR awards totaling close to \$9 million. Examples include a \$700,000 award from DOD (Air Force) to Cerebral Developments, Inc., in Ogden to define an unmanned vehicle-based digital cellular telephone payload system and a \$700,000 award from HHS to Axon Medical, Inc., in Salt Lake City to study cardiac output monitoring from carbon dioxide rebreathing.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Utah are ones valued at more than \$1.8 million from USDA's Cooperative State Research, Education, and Extension Service

(CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Utah every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN UTAH

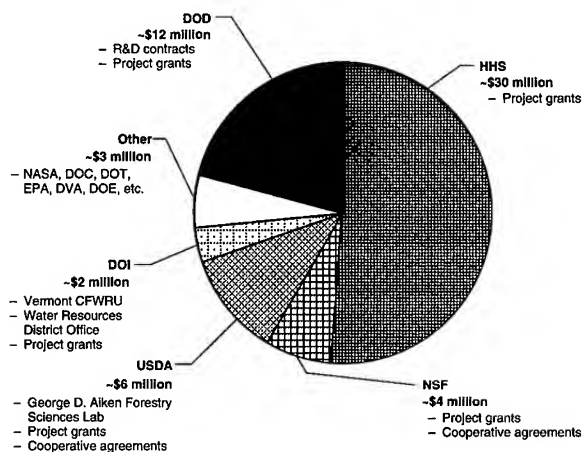
Several entities in Utah also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go from DOD to L-3 Communications (formerly Lockheed Martin Wideband Systems), which in FY 1998 received close to \$26 million from the Navy for work on Common High Bandwidth Data Link Systems and related services. In addition, Alliant Techsystems, Inc. (\$2.5 million), Thiokol Corp. (\$2 million), Lockheed Martin (\$2 million), Cerebral Developments, Inc. (\$1 million), and Reaction Engineering International (\$1 million) received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. For example, Reaction Engineering International received close to \$500,000 in R&D grants in FY 1998. USU (\$25 million) and the U of Utah (\$11 million) also receive contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$4 million of federal R&D dollars was also received in FY 1998 by entities located in Utah in the form of cooperative agreements. The largest of these cooperative agreements (\$1 million in FY 1998) came from DOE to Novatek in Provo, for work on an advanced, integrated, steerable, oil and gas drilling system. Other federal agencies awarding cooperative agreements to Utah-based entities include DOC, USDA, and NSF. Among these latter cooperative agreements is an award supporting one of NSF's Science and Technology Centers—the Center for Computer Graphics and Scientific Visualization at the University of Utah.

Chapter 47

Federal Research and Development in Vermont

- Approximately \$58 million of federal R&D funds are spent each year in Vermont.
- Vermont ranks 50th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 5 percent of all federal funds spent in Vermont each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.



**Figure 47.1 – Sources of Federal R&D Dollars Spent in Vermont
(Total Federal R&D ~\$58 million)**

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$58 million annually in Vermont on research and development (R&D) activities. On average, federal R&D dollars account for approximately 5 percent of all federal funds spent in Vermont each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Vermont. Foremost among these agencies are the Departments of Health and Human Services (HHS), Defense (DOD), and Agriculture (USDA), which account for 51, 21, and 11 percent of all federal R&D dollars spent in the state, respectively. The National Science Foundation (NSF) and the Department of Interior (DOI) account for an additional 7 and 4 percent of the federal R&D dollars spent in Vermont, respectively. The remaining federal R&D dollars come collectively from the National Aeronautics and Space Administration (NASA), the Departments of Energy (DOE) and Transportation (DOT), the Environmental Protection Agency (EPA), and several other federal agencies.⁴⁷

All federal R&D dollars spent in Vermont either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Vermont.

FEDERAL R&D UNITS IN VERMONT

Burlington, Vermont, is home to a unit of DOI's Vermont Cooperative Fish and Wildlife Research Unit and USDA's George D. Aiken Forestry Sciences Laboratory.

- The Vermont Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the cam-

⁴⁷ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

pus of the University of Vermont. It conducts research on the ecology and management of fish, wildlife, and their habitats. Specific research activities of this unit include the ecology of Lake Champlain and Connecticut River fish. It also conducts landscape analyses of the New England area. This federal R&D unit annually receives approximately \$85,000 of federal R&D funds and has one FTE.

- The George D. Aiken Forestry Sciences Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on tree physiology and forest management. Specific research activities of this lab include evaluating the effects of environmental stress on the physiology and morphology of the northern forest ecosystem and investigating social structures and practices pertaining to ecosystem management. This federal R&D unit annually receives approximately \$1.9 million in federal R&D dollars and has about 30 employees.

Montpelier, Vermont, is home to DOI's Vermont District Office of Water Resources.

- The Vermont District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods,

droughts, and waste disposal on water supply and groundwater quality. This federal unit, in combination with the New Hampshire District Office, annually receives approximately \$954,000 in federal R&D funds.

White River Junction, Vermont, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the White River Junction VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 186 projects with total funding of approximately \$5 million. These R&D activities focus on a wide range of topics, including radiotherapy, neoplasms, adjuvant chemotherapy, posttraumatic stress disorder, and leukemia.

FEDERAL R&D GRANTS TO VERMONT ENTITIES

Every major institution of higher education in Vermont is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Vermont. The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and USDA to parties at this in-

Table 47.1 – Sources of Federal R&D Grants to Higher Education in Vermont

	HHS		NSF		USDA		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Vermont	\$29M	139	\$3M	44	\$3M	83	\$2M	24	\$36M	290
Other	<\$1M	5	<\$1M	12	0	0	<\$1M	9	\$1M	26
Total	\$29M	144	\$3M	56	\$3M	83	\$3M	33	\$37M	316

stitution and estimates of the total dollars transferred to them pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Vermont are ones from DOD (\$1 million), while the remainder came from DOE, NASA, and the Department of Education.

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Vermont also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Vermont Alcohol Research Institute in South Burlington (\$600,000), the Vermont State Department of Social Welfare in Waterbury (\$600,000), and the City of Burlington (\$500,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Vermont received 16 SBIR awards totaling close to \$3 million. Examples include a \$750,000 award from DOD (Air Force) to North Dancer Labs, Inc., in Shelburne for work on multiple-channel holographic cinematography and a \$600,000 award from NASA to Concepts ETI, Inc., in White River Junction to develop an integrated turbopump design system with improved performance and reduced cost.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Vermont are ones valued at more than \$1.6 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agricul-

ture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Vermont every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN VERMONT

Several entities in Vermont also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of these funds go from DOD to Lockheed Martin Corp., which in FY 1998 received close to \$8 million from the Army for work on such programs as the development of Light Armored Vehicle Air Defense systems. In addition, Concepts ETI, Inc. (\$1 million), and Kaiser Aerospace & Electronics (\$1 million) also received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to any federal R&D grants also received by these companies. For example, Concepts ETI, Inc., received close to \$100,000 in R&D grants in FY 1998. The University of Vermont (\$500,000) also received contracts from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$4 million of federal R&D dollars was also received in FY 1998 by entities located in Vermont in the form of cooperative agreements. The largest of these cooperative agreements (\$2 million in FY 1998) came from USDA to the University of Vermont in Burlington to coordinate the Northeast Region Sustainable Agriculture Research and Education Program. Other federal agencies awarding cooperative agreements to Vermont-based entities include NSF and DOE.

Chapter 48

Federal Research and Development in Virginia

- Approximately \$4.6 billion of federal R&D funds are spent each year in Virginia.
- Virginia ranks 3rd among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 13 percent of all federal funds spent in Virginia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

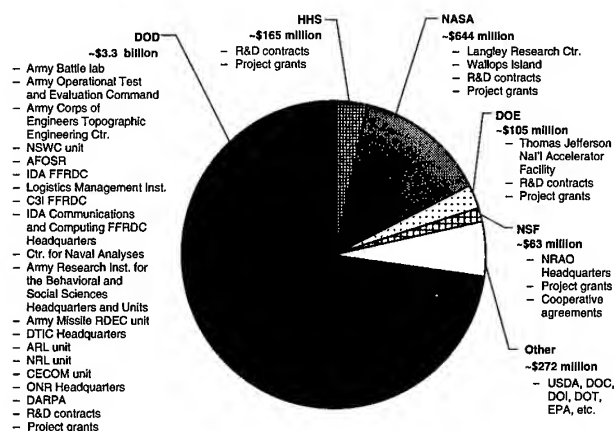


Figure 48.1 – Sources of Federal R&D Dollars Spent in Virginia
(Total Federal R&D ~\$4.6 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$4.6 billion annually in Virginia on research and development (R&D) activities. On average, federal R&D dollars account for approximately 13 percent of all federal funds spent in Virginia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Virginia. Foremost among these agencies is the Department of Defense (DOD), which accounts for 73 percent of all federal R&D dollars spent in the state. The National Aeronautics and Space Administration (NASA) and the Department of Health and Human Services (HHS) account for an additional 14 and 4 percent of the federal R&D dollars spent in Virginia, respectively. The remainder of the federal R&D dollars come collectively from the Departments of Energy (DOE), Interior (DOI), and Transportation (DOT); the National Science Foundation (NSF); the Environmental Protection Agency (EPA); and several other federal agencies.⁴⁸

All federal R&D dollars spent in Virginia either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Virginia.

FEDERAL R&D UNITS IN VIRGINIA

Alexandria, Virginia, is home to DOD's Topographic Engineering Center, the headquarters of the Army Research Institute for the Behavioral and Social Sciences, Army Operational Test and Evaluation Command, Center for Naval Analyses, Institute for Defense Analyses Studies and Analyses FFRDC, and the headquarters of the Institute for

⁴⁸ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

Defense Analyses Communications and Computing Federally Funded Research and Development Center (FFRDC).

- The Topographic Engineering Center is a unit of the Engineer Research and Development Center (ERDC) within DOD's U.S. Army Corps of Engineers. The ERDC is headquartered in Vicksburg, Mississippi, with related units in Champaign-Urbana, Illinois, and Hanover, New Hampshire. The center's R&D efforts concentrate on mapping, geodesy, space, remote sensing, spectral analysis, point positioning, surveying and land navigation, 3-D battlefield visualizations, modeling, and distributed interactive simulations. It is also involved in assessing the environmental effects on tactical equipment movement, topographic support systems, and terrain analyses. The center serves as a primary source for Army terrain analysis, as well as DOD water resources data and water detection activities. This federal unit annually receives about \$36 million in federal R&D funds, approximately \$11 million of which is spent on in-house activities, and has about 345 civilian personnel.
- The Army Research Institute for the Behavioral and Social Sciences is a unit of DOD headquartered in Alexandria, Virginia. Additional sites are located in Fort Rucker, Alabama; Fort Benning, Georgia; Fort Leavenworth, Kansas; Fort Knox, Kentucky; Fort Bragg, North Carolina; Orlando, Florida; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. It conducts research on personnel performance and training for the Army. Its R&D specifically focuses on personnel issues related to recruitment, selection, assignment, training, and mission performance. The institute's research is central to developing new techniques for collective training in the field, designing realistic ways of training while fighting, forging cohesive and committed units, and developing integrated leadership systems at all levels. This federal unit annually receives approximately \$14 million of federal R&D funds, only about half of which is spent on in-house activities, and has about 53 civilian personnel directly involved in R&D activities.

- The Operational Test and Evaluation Command is a unit of the Army inside DOD. It plans and conducts joint and multiservice operational tests. The command's programs focus on such areas as the security of armored vehicles, shelter from chemical and biological threats, and the detection and destruction of armor. It conducts R&D on the effectiveness, suitability, and survivability of operational systems and manages the Army's Continuous Evaluation Program. This federal unit annually receives about \$127 million of federal R&D funds, approximately \$123 million of which are spent on in-house activities, and has a staff of about 1,450, almost 900 of whom are civilians.
- The Center for Naval Analyses is an FFRDC sponsored by DOD's Navy and operated by the CNA Corporation. The center conducts R&D to find more effective and efficient ways to recruit, train, equip, support, and use naval forces. Research activities focus on such areas as current operations, future strategies, technologies, and force structures; military health care; space technology; veterans' transition and defense conversion; transition of women into combat units; and joint task force training. The center also provides detailed, objective assessments of the costs and benefits of alternative military systems that the services are interested in buying. This federally owned and contractor-operated R&D unit annually receives approximately \$46 million of core funding, all of which is federal R&D funds, and has about 260 employees.
- The Institute for Defense Analyses Studies and Analyses FFRDC is sponsored by the Secretary of Defense and operated by the Institute for Defense Analyses, a nonprofit organization. The institute provides studies, analyses, software prototypes, simulations, and other models to address national security issues involving defense systems, technologies, operations, strategies, and resources. This federally owned and contractor-operated R&D unit annually receives approximately \$78 million of core funding, all of which is federal R&D funds, and has about 400 employees.

- The Institute for Defense Analyses Communications and Computing FFRDC is sponsored by DOD's National Security Agency and operated by the Institute for Defense Analyses, a nonprofit organization. It conducts R&D in such areas as cryptomathematics, cryptocomputing, speech research, and special signal processing techniques. It is nominally headquartered in Alexandria, Virginia, with its operational activities located in La Jolla, California; Bowie, Maryland; and Princeton, New Jersey. The combined portions of this federally owned and contractor-operated R&D unit annually receive approximately \$35 million of core funding, all of which is federal R&D funds, and have about 150 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Arlington, Virginia, is home to DOD's Office of Naval Research, Air Force Office of Scientific Research, and Defense Advanced Research Projects Agency.

- The Office of Naval Research is a unit of DOD. It is the headquarters of R&D Management Command, which oversees the extramural R&D programs of the Navy and Marine Corps performed by universities, nonprofit organizations, or for-profit companies. It sponsors extramural R&D programs in information, electronics, and surveillance; ocean, atmosphere, and space; engineering, materials, and physical science; human systems; and naval expeditionary warfare. It also provides technical advice to the Chief of Naval Operations and the Secretary of the Navy, works with industry to improve technology manufacturing processes while reducing fleet costs, and fosters continuing academic interest in naval-relevant science. This federal unit annually awards about \$954 million in R&D grants and contracts and spends approximately \$33.4 million of federal R&D funds to support the in-house management activities of about 380 FTEs.
- The Air Force Office of Scientific Research is a unit of DOD. It manages all basic research conducted by and for the U.S. Air

Force. One of the tools used to accomplish this is to solicit proposals for research through a number of broad and specialized announcements. It invites proposals for basic research in the following broad areas: physics, solid mechanics and structures, chemistry, mathematics and computer sciences, electronics, structural materials, fluid mechanics, propulsion, atmospheric sciences, space sciences, biological sciences, human performance, and science and engineering education programs. This federal unit annually receives about \$230 million of federal R&D funds, only a fraction of which is spent on-site, and has about 100 civilian personnel. The vast majority of the R&D dollars received by this unit are dispersed throughout the nation as grants and/or contracts.

- The Defense Advanced Research Projects Agency (DARPA) is the central R&D unit inside DOD. It manages and directs R&D projects, with an emphasis on activities with dual-use possibilities. In addition, it supports high-risk and big-payoff R&D opportunities that have the potential of making dramatic advances in military operations and capabilities. This federal unit annually receives approximately \$2 billion of federal R&D funds, all but about \$36 million of which leaves the DARPA headquarters unit in Arlington and is dispersed to sites around the nation to support extramural R&D activities. As such, these federal R&D funds are reflected elsewhere in this report as R&D grants, contracts, and cooperative agreements awarded by DOD to universities, corporations, nonprofit organizations, and other eligible entities. This federal unit has about 180 civilian FTEs, all of whom are directly involved in R&D activities.

Blacksburg, Virginia, is home to USDA's Forest Service R&D Work Site at Virginia Tech and DOI's Virginia Cooperative Fish and Wildlife Research Unit.

- The R&D Work Site at Virginia Tech is a unit of the Southern Research Station inside USDA's Forest Service located on the campus of Virginia Tech University. It conducts research on

coldwater streams and trout habitat in the southern Appalachians; tree quality assessment; automated wood processing; and solid wood recovery, reuse, and recycling. Specific research activities of this unit include identifying the factors that influence the distribution, abundance, and production of trout and other coldwater fish in the southern Appalachians; providing the technical basis for protecting, enhancing, and restoring coldwater streams and their fauna; enhancing wood resource conservation and sustainability through advanced timber analysis and wood processing; and extending the life of wood resources by developing new or improved recycling methods to refurbish or reuse wood pallets and other solid wood products. This federal R&D unit annually receives approximately \$880,000 of federal R&D funds and has about 11 employees.

- The Virginia Cooperative Fish and Wildlife Research Unit is part of DOI's U.S. Geological Survey (USGS). It is on the campus of Virginia Tech. It conducts research on forest management and wildlife impacts, recovery of America's endangered aquatic animals, minimizing water pollution from fish farms, wildlife ecology, wildlife forestry interactions, conservation biology, human dimensions of fisheries and wildlife management, stream fisheries ecology, reservoir fisheries ecology, and aquaculture genetics. Specific research activities of this unit include biology and conservation of freshwater mussels, endangered aquatic species, restoration and recovery of aquatic ecosystems, propagation of endangered mollusks, and predator/prey interactions. This federal R&D unit annually receives approximately \$277,000 of federal R&D funds and has about three FTEs.

Charlottesville, Virginia, is home to a portion of NSF's National Radio Astronomy Observatory.

- The National Radio Astronomy Observatory (NRAO) is an FFRDC sponsored by NSF and operated by Associated Universities, Inc. It is headquartered in Charlottesville, Virginia, with observing sites in Green Bank, West Virginia; Tucson, Arizona; and Socorro, New Mexico. NRAO was established to ensure

that all qualified scientists have access to radio astronomy facilities. NRAO's Central Development Laboratory (CDL) in Charlottesville is responsible for many advanced project developments. Specifically, the CDL produces various components that are incorporated into NRAO systems to support observational radio astronomy. Some of these, such as amplifiers and mixers, are unique designs for cryogenic operation that outperform their commercial counterparts. On occasion, these components are made available to other observatories and research organizations on a cost-reimbursement basis. Each year the four sites of this federally owned and consortium-operated unit collectively receive approximately \$44 million of federal R&D funds to conduct operations. The Charlottesville site annually receives approximately \$7 million in these federal R&D funds and has about 71 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Dahlgren, Virginia, is home to DOD's Naval Surface Warfare Center Dahlgren Division.

- The Naval Surface Warfare Center Dahlgren Division is a unit of DOD. It conducts R&D on surface warfare, surface ship combat systems, ordnance, strategic systems, mines, amphibious warfare systems, mine countermeasures, and special warfare systems. The Dahlgren Division maintains a facility at Wallops Island, Virginia. Together these two federal units annually receive about \$482 million of federal R&D funds, approximately \$242 million of which are spent on in-house activities, and has about 4,286 civilian personnel, only a portion of whom are involved in R&D activities. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Fort Belvoir, Virginia, is home to a portion of DOD's Communications-Electronics Command Research, Development, and Engineering Center and the headquarters of the Defense Technical Information Center.

- The Night Vision and Electronic Sensors Directorate is part of DOD's Army Communications-Electronics Command Research, Development, and Engineering Center. The center conducts R&D on information technologies and integrated systems for U.S. warfighters. It is headquartered in Fort Monmouth, New Jersey, with an additional location in Fort Belvoir, Virginia. The directorate at Fort Belvoir provides sensor and sensor suite technologies to see and control the digital battlefield, including thermal imaging, sensor fusion, optics, countermeasure, and image display technologies. This federal unit annually receives about \$136 million of federal R&D funds, approximately \$28.8 of which are spent on in-house activities, and has about 537 FTEs, only a portion of whom are directly involved in R&D activities. A portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.
- DOD's Defense Technical Information Center (DTIC), a unit of the Defense Information Systems Agency (DISA), supports all DOD R&D activities by providing access to and facilitating the exchange of scientific and technical information. DTIC's collection covers research on a wide range of topics, including biology, chemistry, energy, environmental sciences, oceanography, computer sciences, sociology, logistics, and human factors engineering. In addition to the headquarters in Virginia, DTIC maintains regional offices in Massachusetts, Ohio, New Mexico, and California. This federal unit annually receives approximately \$33 million in federal R&D funds and employs about 350 people.

Fort Eustis, Virginia, is home to DOD's Army Missile Research, Development, and Engineering Center Aviation Applied Technology Directorate.

- The Aviation Applied Technology Directorate is a unit of DOD's Army Missile Research, Development, and Engineering Center, headquartered in Huntsville, Alabama. It conducts R&D on aircraft systems integration; safety and survivability; structures, propulsion, reliability, maintainability, and mission technology;

cognitive decision aids; and weaponization system concepts. Specific R&D activities focus on such matters as reducing the detectability of helicopters; improving aircraft weapons fire control; developing ballistic tolerant fuel systems; improved cargo handling; and systems integration of advanced systems, subsystems, and concepts. This federal unit annually receives approximately \$53.6 million in federal R&D funds, approximately \$13.6 million of which are spent on in-house activities, and has about 220 civilian personnel, most of whom are directly involved in R&D activities. In October 1999, the Aviation Research, Development, and Engineering Center was provisionally merged with the Missile Research, Development, and Engineering Center, which is also headquartered in Huntsville, Alabama.

Fort Lee, Virginia, is home to DOD's Combat Service Support Battle Laboratory.

- The Combat Service Support Battle Laboratory is a unit of the Army inside DOD. It is one of 11 battle laboratories established to define the horizontally integrated capabilities required to operate and field an effective Army. It seeks to improve combat by finding, evaluating, and transitioning successful commercially available technology for use by the Army. Specific R&D activities of this laboratory focus on such matters as improving the use of remotely gathered sensor data on combat and tactical vehicles, developing the capability to deliver containerized cargo to remote areas, and simulating logistics at a fidelity on par with warfighting on the synthetic battlefield. This federal unit annually receives about \$1.8 million of federal R&D funds, only a portion of which is spent in-house, and has four civilian personnel.

Fort Monroe, Virginia, is home to DOD's TRADOC Scientific Coordination Office.

- The TRADOC Scientific Coordination Office is a unit inside DOD's Army Research Institute for Behavioral and Social Sci-

ences headquartered in Alexandria, Virginia. Additional sites are located in Orlando, Florida; Fort Benning, Georgia; Fort Knox, Kentucky; Fort Rucker, Alabama; Fort Leavenworth, Kansas; Fort Bragg, North Carolina; Fort Hood, Texas; Heidelberg, Germany; and Boise, Idaho. The unit provides information and recommendations for the development of research programs, provides input for long-range program planning, coordinates support for research planning issues, and develops mechanisms for the implementation and utilization of research products within TRADOC. This federal R&D unit annually receives approximately \$423,000 in federal R&D funds, only a portion of which is spent on in-house R&D activities, and has about two civilian personnel directly involved in R&D activities.

Front Royal, Virginia, is home to the Smithsonian Institution's National Zoological Park Conservation and Research Center.

- The National Zoological Park Conservation and Research Center is a unit of the Smithsonian Institution. The center is the only unit of the Smithsonian Institution exclusively devoted to the study of wildlife conservation biology. Its mission is to advance conservation of biological diversity. The center investigates threatened species, habitats, and communities, providing integrated approaches that address wildlife conservation from the broad expanse of landscapes to the minute subcellular realm of genetics. This federal unit receives approximately \$3.8 million in federal R&D funds and has about 51 FTEs.

Hampton, Virginia, is home to NASA's Langley Research Center, a portion of DOD's Army Vehicle Structures Directorate, and a Department of Veterans Affairs (DVA) R&D unit.

- The Langley Research Center is a unit of NASA. It conducts R&D on aeronautics, atmospheric sciences, and space technology. Most of the center's R&D activities focus on aeronautics to improve aircraft and develop concepts for future aircraft. Specific R&D activities focus on such areas as systems analysis, integration, and assessment; aerodynamics; aerothermodynamics;

hypersonic propulsion; structures; materials; atmospheric sciences; remote sensing; and airborne systems. The center also conducts R&D on structures and materials, testing them in wind tunnels and other facilities. The center's researchers also develop technology for advanced space transportation systems and for small spacecraft and instruments. This federal facility annually receives a total of about \$651 million, at least \$418 million of which directly involves R&D efforts. The center has about 2,420 FTEs, only a portion of whom are involved in R&D activities. A substantial portion of its funds is spent on the maintenance and operation of R&D equipment and facilities. In a recent year, the center awarded over \$229 million of R&D contracts, about \$46 million of which were made to entities based in Virginia.

- The Vehicle Structures Directorate is a unit of DOD's Army Research Laboratory. The laboratory is headquartered in Adelphi, Maryland, with additional sites in Aberdeen, Maryland; White Sands, New Mexico; Cleveland, Ohio; Eatontown, New Jersey; and Atlanta, Georgia. The portion of it located in Virginia is responsible for developing and advancing technologies in the areas of rotorcraft aerodynamics and air/ground vehicle structures and is located at the NASA Langley Research Center. A closely related unit is located at the Langley Research Center in Virginia. By sharing federal R&D facilities with NASA, the Army has access to state-of-the-art wind tunnels, noise chambers, and other test equipment for only a fraction of their total cost. The directorate's R&D activities focus on such areas as vehicle designs and prototypes, crashworthiness of rotorcraft, vibrations and acoustics, and material and structural fatigue and fracture. This federal unit annually receives approximately \$3.6 million of federal R&D funds, about \$3.4 million of which is spent on in-house activities, and has about 49 civilian personnel, only a portion of whom are directly involved in R&D activities.

- While the principal focus of the Hampton VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 34 projects with total funding of approximately \$115,000. These R&D activities focus on a wide range of topics, including posttraumatic stress disorders, substance abuse, and prostatic neoplasms.

McLean, Virginia, is home to DOD's Logistics Management Institute FFRDC and Command, Control, Communications, and Intelligence FFRDC, DOT's Center for Advanced Aviation System Development and Turner-Fairbank Highway Research Center, and the Department of the Treasury's Center for Strategic Tax Administration Modernization.

- The Logistics Management Institute (LMI) FFRDC is sponsored by the Office of the Secretary of Defense and operated by LMI, Inc., a nonprofit entity with additional activities in Bel Air, Maryland, and Brussels, Belgium. It conducts R&D on general logistics, acquisition, and manpower issues, as well as national security matters in which logistics, acquisition, or manpower issues play a central role. This federally owned and contractor-operated R&D unit annually receives approximately \$30 million of core funding, all of which is federal R&D funds, and employs about 200 people.
- The Command, Control, Communications, and Intelligence FFRDC is sponsored by the Office of the Secretary of Defense (OSD) and operated by the MITRE Corporation. It conducts R&D on command, control, communications, and intelligence systems for DOD and the intelligence community. The center has three divisions, the Center for Air Force Integrated Intelligence Systems, the Center for Integrated Intelligence Systems, and the C3 Center. The first two divisions are in Bedford, Massachusetts. The latter division conducts R&D in advanced information systems, software development, communications, networking, signal processing, and electronics. Of the three divisions that constitute the center, only the one focused on com-

mand, control, and communications activities is in Virginia. The combined divisions of this federally owned and contractor-operated facility annually receive about \$200 million of federal R&D funds and employ approximately 1,450 people.

- The Center for Advanced Aviation System Development is an FFRDC sponsored by DOT's FAA and operated by the MITRE Corporation. It conducts research related to airway facilities, air traffic, airspace systems capacity, and aviation safety. All R&D activities of the center are specifically designed to help the FAA and other civil aviation sponsors plan, acquire, and implement their future air traffic management systems. It works with domestic and foreign units, with a focus on the need for a safe and efficient air traffic management environment, to conform to the standards and recommended practices of the International Civil Aviation Organization. Specific research activities of this FFRDC focus on solving systemwide problems resulting in delay and other inefficiencies, researching flow efficiency within transition in airspace, developing airport acceptance and departure rates, and researching ways to decrease inefficient airport surface operations. This federal unit annually receives approximately \$5 million in federal R&D funds and has about 500 employees.
- The Turner-Fairbank Highway Research Center is a unit inside DOT's Federal Highway Administration. It conducts research on highway technologies. Specific research activities of this center focus on providing solutions to complex technical problems through the development of more economical, environmentally sensitive highway designs; more efficient, quality-controlled highway construction practices; and more durable highway materials. The center also conducts research in safety, intelligent systems, pavements, structures, and human factors. This federal unit annually receives approximately \$2 million in federal R&D funds and has about 108 employees.
- The Center for Strategic Tax Administration Modernization is an FFRDC sponsored by the Internal Revenue Service (IRS)

within the Department of the Treasury and operated by the MITRE Corporation. It provides strategic, technical, and program management advice, guidance, and support services to facilitate the operation and modernization of the tax system. The center was established as an FFRDC to provide a special relationship between the IRS and the contractor that is confidential and free from organizational conflict of interest. This federally owned and contractor-operated unit annually receives approximately \$20 million in federal funds and has about 116 employees. None of the funds received by this FFRDC have been reported to OMB as being R&D dollars, because the IRS does not consider the activities of this FFRDC to be R&D. As a result, none of the activities of this FFRDC is included in official federal R&D budget. Because this unit is a federally funded *research and development* center, however, it has been included in this report.

Newport News, Virginia, is home to DOE's Thomas Jefferson National Accelerator Facility and DOC's *Monitor* Marine Sanctuary.

- The Thomas Jefferson National Accelerator Facility, formerly known as the Continuous Electron Beam Accelerator Facility, is an FFRDC sponsored by DOE and operated by the Southeastern Universities Research Association, Inc., a consortium of 41 universities in the southeastern United States. It conducts research in nuclear physics to reveal how nature structures the nucleus and orchestrates its behavior. In addition to its fundamental basic research mission, the lab studies free electron lasers, superconducting radio frequency accelerating cavities, cryogenics, particle detection, gamma emission mammography, ultrahigh vacuum technology, and real-time data acquisition systems. This federally owned and contractor-operated facility annually receives approximately \$69 million in core funding, all of which is spent on specific R&D project, and has about 500 employees. A substantial portion of the facility's funds is spent on the maintenance and operation of R&D equipment and facilities.

- The *Monitor* National Marine Sanctuary is a unit of DOC's National Oceanic and Atmospheric Administration (NOAA). Such sanctuaries conduct research on the marine environment to identify areas of special national significance stemming from their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific R&D activities of this unit include studying the changes in the ship structure stemming from natural deterioration and human impact; determining currents, erosion, depositional patterns, and the nature of the water column around the wreck; and studying corrosion through data generated by electric field gradient measurements, structure-to-structure electrolyte potential measurements, and other tests. This federal unit annually receives approximately \$75,000 of federal R&D funds and has one FTE.

Quantico, Virginia, is home to DOD's Naval Research Laboratory Midway Research Center.

- The Midway Research Center is a unit of DOD's Naval Research Laboratory. It conducts R&D on space-related applications involving communications and navigation. The funding and staffing information for the center is modest and is included in that presented for the main laboratory in the District of Columbia.

Reston, Virginia, is home to DOI's National Mapping Center, Biological Resources Division headquarters, and Geologic Eastern Regional Office.

- The National Mapping Center is a unit of DOI's USGS. It is located in the headquarters of DOI's National Mapping Division in Reston. It promotes the standardization and the availability of digital mapping data, methods, and products. Specific research activities of this center include providing remote sensing data collection and analysis, mapping, environment, and emergency response issues. The unit uses GIS and other digital cartographic tools to create maps, compile digital data from satel-

lite images and aerial photographs, and develop new mapping methods and applications. This federal R&D unit and the division headquarters annually receive approximately \$5.7 million in federal R&D funds and have about 424 FTEs, only about 50 of whom are directly involved in R&D.

- The Biological Resources Division Headquarters is a unit of DOI's USGS. It houses programmatic planning officers, including the Chief Biologist, the Deputy Chief Biologist for Science, the Deputy Chief Biologist for Operations, the Assistant Chief Biologist for Information, and the Chief of Cooperative Research Units. The headquarters office annually receives approximately \$7.9 million of federal R&D funds and has about 80 FTEs. Additionally, it receives approximately \$5.6 million of federal R&D funds for administrative costs and approximately \$283,000 for space costs. The Cooperative Research Units office in Reston annually receives approximately \$1.3 million of federal R&D funds and has about six FTEs. In sum, this federal R&D unit annually receives approximately \$15.1 million of federal R&D funds and has about 86 FTEs.
- The Geologic Eastern Regional Office is a unit inside DOI's USGS. It oversees the R&D activities of Wisconsin, Illinois, Michigan, Indiana, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Virginia, West Virginia, Ohio, Pennsylvania, the District of Columbia, Maryland, Delaware, New Jersey, Connecticut, Rhode Island, New York, Massachusetts, Vermont, New Hampshire, and Maine. These activities include research on geophysics, geochronology, earthquakes, landslide hazards, geochemistry, geologic mapping, climate change, oil and gas assessment, environmental monitoring and remediation, coal resource assessment, paleontology, and ecosystem analysis. Specific research activities in these regions focus on investigating the role of mineral resource assessments in ecological stewardship, studying methane hydrates, and coastal mapping along New York's shores. Two research centers affiliated with this office are lo-

cated in St. Petersburg, Florida, and Woods Hole, Massachusetts. This federal R&D unit annually receives approximately \$36 million of federal R&D funds, which are dispersed throughout all the states in the eastern region, as are its employees.

Richmond, Virginia, is home to DOI's Virginia District Office of Water Resources and a DVA R&D unit.

- The Virginia District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit and the headquarters of the Water Resources Division in Reston annually receive approximately \$11 million in federal R&D funds.
- While the principal focus of the Hunter Holmes McGuire VA Medical Center in Richmond is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 334 projects with total funding of approximately \$5 million. These R&D activities focus on a wide range of topics, including pharmacokinetics, hepatitis, heart-assist devices, and neoplasms.

Salem, Virginia, is home to a DVA R&D unit.

- While the principal focus of the Salem VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 56 projects with total funding of less than \$25,000. These R&D activities focus on a wide range of topics, including diabetes, HIV, and depression.

Wallops Island, Virginia, is home to NASA's Wallops Flight Facility.

- The Wallops Flight Facility is a unit of NASA's Goddard Space Flight Center in Greenbelt, Maryland. It oversees NASA's sub-orbital research programs. Researchers at the unit analyze and design mission, payload, and attitude control systems, as well as operationally test, integrate, and certify NASA and commercial orbital launch technologies. The unit houses facilities for fabrication, payload integration, and environmental testing. This federal unit annually receives approximately \$120 million of federal R&D funds and has about 256 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

FEDERAL R&D GRANTS TO VIRGINIA ENTITIES

Every major institution of higher education in Virginia is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOD to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Virginia, Virginia Commonwealth University (VCU), Virginia Polytechnic Institute and State University (Virginia Tech), Hampton University, the College of William and Mary (W&M), George Mason University, Old Dominion University, and Eastern Virginia Medical School (EVMS). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, and DOD to parties

at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Virginia are ones from NASA (\$4 million) and DOE (\$2 million). Nearly all of the \$2 million in comparable grants going to VCU were from the Department of Education. The grants in this same category going to Virginia Tech were distributed primarily among USDA (\$6 million), NASA (\$2 million), and DOE (\$1 million). The majority of such grants going to William and Mary were split between EPA and DOE. Similarly, NASA and DOE share the grants in this category going to both Old Dominion and Hampton University.

Table 48.1 – Sources of Federal R&D Grants to Higher Education in Virginia

Institution	HHS		NSF		DOD		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Virginia	\$74M	397	\$9M	179	\$5M	34	\$7M	113	\$96M	723
VCU	\$42M	206	\$1M	17	\$1M	8	\$2M	20	\$46M	251
Virginia Tech	\$3M	27	\$7M	150	\$6M	38	\$10M	335	\$26M	550
Hampton	\$1M	7	\$1M	13	\$2M	9	\$3M	45	\$7M	74
W&M	<\$1M	6	\$4M	63	\$1M	6	\$2M	42	\$7M	117
George Mason	\$1M	8	\$2M	39	\$2M	22	\$1M	23	\$6M	92
Old Dominion	<\$1M	5	\$2M	39	\$1M	16	\$3M	79	\$6M	139
EVMS	\$4M	24	0	0	<\$1M	1	<\$1M	1	\$4M	26
Other	\$1M	9	\$1M	27	\$1M	6	\$5M	75	\$7M	117
Total	\$127M	689	\$26M	527	\$19M	140	\$33M	733	\$205M	2,089

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Marine Institute at William and Mary.

Several other nonacademic institutions in Virginia also receive a significant amount of federal R&D grants each year. Foremost among

the institutions that received R&D grants in FY 1998 are the American College of Radiology in Reston (\$7 million), the American National Red Cross Headquarters in Falls Church (\$6 million), Emmes Corporation in McLean (\$4 million), Fu Associates in Arlington (\$3 million), and the Water Environment Research Foundation in Alexandria (\$3 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Virginia received 260 SBIR awards totaling \$61 million. Examples include a \$750,000 award from DOD (Defense Threat Reduction Agency) to Pacific-Sierra Research Corporation in Arlington to develop speed-accuracy measures for distributed interactive simulation of nuclear weapons effects and a \$400,000 award from NSF to Signal Separation Tech in Annandale for work on a new active vibration control method for precision machines.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Virginia are ones valued at more than \$5.9 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from the USGS in DOI to the Water Resources Research Institute in Virginia every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN VIRGINIA

Several entities in Virginia also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific

R&D efforts. The majority of these funds go from DOD to Bell-Boeing (an alliance of Bell Helicopter Textron and the Boeing Company), which in FY 1998 received close to \$336 million from a continuing Naval Air Systems Command R&D contract to develop the V-22 Osprey tiltrotor aircraft. In addition, a large portion of federal R&D contract funds went from DOD to Lockheed Martin Corporation (\$304 million) for support of such programs as the Army's Close Combat Tactical Trainer, NSSN-class submarine C3I system hardware, and the DOD Global Transportation Network. Also, Computer Sciences Corporation (\$152 million), BDM International (\$61 million), Orbital Sciences Corporation (\$45 million), and Digital System Resources (\$40 million) received very large R&D contracts from federal agencies in FY 1998. Virginia Tech (\$4 million), VCU (\$4 million), Old Dominion (\$3 million), George Mason University (\$3 million), and the University of Virginia (\$2 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$40 million of federal R&D dollars was also received in FY 1998 by entities located in Virginia in the form of cooperative agreements. By far, the largest of these cooperative agreements (\$11 million in FY 1998) came from NSF to MCI in McLean to provide very high speed backbone network service for the NSFNET. These cooperative agreements also include awards supporting two of NSF's Science and Technology Centers—the Center for Biological Timing at the University of Virginia and the Center for High-Performance Polymeric Adhesives and Composites at Virginia Tech. Other federal agencies awarding cooperative agreements to Virginia-based entities include DOD, DOC, and DOE.

Chapter 49

Federal Research and Development in Washington

- Approximately \$1.3 billion of federal R&D funds are spent each year in Washington.
- Washington ranks 18th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 8 percent of all federal funds spent in Washington each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

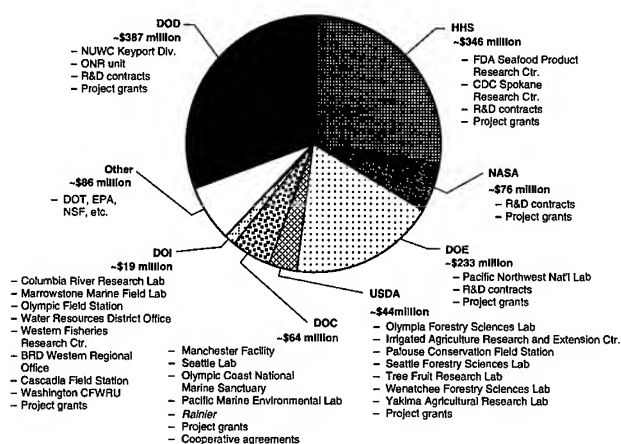


Figure 49.1 – Sources of Federal R&D Dollars Spent in Washington
(Total Federal R&D ~\$1.3 billion)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$1.3 billion annually in Washington on research and development (R&D) activities. On average, federal R&D dollars account for approximately 8 percent of all federal funds spent in Washington each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Washington. Foremost among these agencies are the Departments of Defense (DOD), Health and Human Services (HHS), and Energy (DOE), which account for 31, 28, and 19 percent of all federal R&D funds spent in the state, respectively. The National Aeronautics and Space Administration (NASA), the Department of Commerce (DOC), the National Science Foundation (NSF), and the Department of Agriculture (USDA) account for an additional 6, 5, 4, and 3 percent of all federal funds spent in the state, respectively. The remaining federal R&D dollars come collectively from several other agencies.⁴⁹

All federal R&D dollars spent in Washington either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Washington.

FEDERAL R&D UNITS IN WASHINGTON

Bothell, Washington, is home to HHS's Seafood Product Research Center.

- The Seafood Product Research Center is a unit of HHS's Food and Drug Administration (FDA). It conducts research on a wide variety of seafood, including finfish, crustaceans, aquatic animals, shellfish, and terrestrial food. Research analyses centers

⁴⁹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

on marine toxins, antibiotics in seafood, molecular biology/gene technology, and seafood/aquaculture bacteriology. Co-located with the center is FDA's Pacific Regional Laboratory-Northwest, which conducts a small amount of research on the safety and efficacy of human and animals drugs. Together these two federal units annually receive approximately \$1.5 million of federal R&D dollars and have about 20 FTEs directly involved in R&D activities.

Cook, Washington, is home to the Department of Interior's (DOI's) Columbia River Research Laboratory.

- The Columbia River Research Laboratory (CRRL) is a unit of the Western Fisheries Research Center inside DOI's U.S. Geological Survey (USGS). It conducts research on fish populations and aquatic ecosystems of the west. The CRRL has the facilities and resources to carry out research in behavioral and physiological ecology of salmonids, white sturgeons, and Pacific lampreys. Specific research activities of this unit include studying the effects of hydropower development on fish passage and population dynamics. This federal R&D unit annually receives approximately \$20,000 of federal R&D funds and has about two FTEs.

Keyport, Washington, is home to DOD's Naval Undersea Warfare Center Keyport Division.

- The Naval Undersea Warfare Center Keyport Division is a unit of DOD. It supports underwater research in both littoral and continental shelf environments. This federal unit annually receives approximately \$4.8 million in federal R&D dollars for in-house activities and has about 1,454 civilian personnel, only a fraction of whom are involved in R&D activities.

Manchester, Washington, is home to DOC's Manchester Facility.

- The Manchester Facility is a unit of the Northwest Fisheries Science Center inside DOC's National Oceanic and Atmospheric Administration (NOAA). The facility coordinates research with

the center in the areas of conservation biology, environmental conservation, fishery resources analysis and monitoring, fish ecology, and resource enhancement and utilization technologies. It also conducts research on salmon recovery, particularly endangered species. Specific research activities of this facility focus on Pacific salmon conservation, salmon reintroduction to rivers, and aquaculture. This federal unit annually receives approximately \$422,000 of federal R&D funds and has about five FTEs, only a portion of whom are involved in R&D activities.

Nordland, Washington, is home to DOI's Marrowstone Marine Field Laboratory.

- The Marrowstone Marine Field Laboratory is a unit of the Western Fisheries Research Center inside DOI's USGS. It conducts research on fish populations and aquatic ecosystems of the west. Because the station has access to exceptionally high-quality seawater and has USGS's only seawater laboratory, it constitutes a critical research asset nationwide. Specific research activities of this unit include experiments that depend on laboratory rearing of saltwater organisms, such as characterizing the effects of stress and disease on salmon and trout as they transform to a saltwater metabolism, and characterizing effects of contaminants on marine species and life stages, and marine species rearing technology. This federal R&D unit annually receives approximately \$52,000 of federal R&D funds and has about three FTEs.

Olympia, Washington, is home to USDA's Olympia Forestry Sciences Laboratory.

- The Olympia Forestry Sciences Laboratory is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. It conducts research on developing cost-effective techniques for aquatic and riparian habitat restoration and management, understanding the interaction of wildlife associated with older forests, and the operational aspects of managing coniferous and mixed species stands. Specific research activities of this lab-

oratory include fish studies that will examine the migratory behavior adult and juvenile salmonids and managing the biological diversity of the Pacific Northwest. This federal R&D unit annually receives approximately \$3.8 million of federal R&D funds and has about 45 employees.

Port Angeles, Washington, is home to DOI's Olympic Field Station and DOC's Olympic Coast National Marine Sanctuary.

- The Olympic Field Station is a unit of the Forest and Rangeland Ecosystem Science Center inside DOI's USGS. It conducts research at the administrative headquarters of Olympic National Park. Specific research activities of this unit include resolving problems that arise from managing this park. The majority of the staff are former employees of the National Park Service. This federal R&D unit annually receives approximately \$318,000 of federal R&D funds and has about 14 FTEs.
- The Olympic Coast National Marine Sanctuary is a unit of DOC's NOAA. Such sanctuaries conduct research on the marine environment to identify areas of special national significance stemming from their resource or human-use values and on the conservation and management of these marine areas, including restoration of damaged ecosystems. Specific R&D activities of this unit include studying such resource management issues as vessel traffic, spill prevention and response, water quality, and the ecological impact of fishing in one of the most diverse marine mammal habitats in North America. This federal unit annually receives approximately \$50,000 of federal R&D funds and has about five FTEs.

Prosser, Washington, is home to USDA's Irrigated Agriculture Research and Extension Center.

- The Irrigated Agriculture Research and Extension Center is a unit of USDA's Agricultural Research Service (ARS). It is on the Prosser campus of Washington State University. It conducts research on the development of economically and technically feasible, integrated cropping systems for irrigated farming to im-

prove economic returns and food/forage quality, and minimize environmental impacts. Specific research activities of this unit include a project on potato variety development through gene transfer and virology and bean and pea germplasm enhancement for disease and environmental stress resistance. This federal R&D unit annually receives approximately \$2.5 million of federal R&D funds and has about 30 FTEs.

Pullman, Washington, is home to USDA's Palouse Conservation Field Station.

- The Palouse Conservation Field Station is a unit of USDA's ARS located on the Pullman campus of Washington State University. It consists of seven research divisions focusing on animal diseases; grain legumes genetics and physiology; land management and water conservation; nonirrigated agriculture weed science; plant germplasm introduction and testing; root disease and biological control; and wheat genetics, quality physiology, and disease. The research focus of these divisions includes developing methods for diagnosis, immune protection, and a detailed understanding of the disease processes; identifying germplasm for disease and insect resistance and for environmental adaptation; and improving germplasm for grain quality characteristics, environmental stress tolerance, and disease resistance. Specific research activities include investigating diseases in domestic animals, including anaplasmosis, scrapie bovine and equine babesiosis, and malignant catarrhal fever; determining the genetic diversity within specific crop collections to reduce redundancy; and developing wheat cultivars that ensure economic viability, reduction of pesticides, and conservation of natural resources. This federal R&D unit annually receives approximately \$8.3 million of federal R&D funds and has about 94 FTEs.

Richland, Washington, is home to DOE's Pacific Northwest National Laboratory.

- The Pacific Northwest National Laboratory is a federally funded research and development center (FFRDC) sponsored by DOE

and operated by the Battelle Memorial Institute. It conducts research focusing on developing fundamental knowledge of natural, engineered, and social systems that is the basis for both effective environmental technology and sound public policy. The laboratory addresses legacy environmental problems by developing technologies that remedy existing environmental hazards. The vast majority of the laboratory's work concerns environmental science, environmental technology, or both. The laboratory also does work on national security and energy missions. This federally owned and contractor-operated R&D unit annually receives approximately \$287 million of core funding, virtually all of which is spent on specific R&D projects, and has about 7,250 employees. A portion of the facility's funds is spent on the maintenance and operation of R&D equipment and facilities.

Seattle, Washington, is home to a unit of DOD's Office of Naval Research; DOC's Seattle Laboratory, Pacific Marine Environmental Laboratory, and research ship *Rainier*; DOI's Western Fisheries Research Center and Biological Resources Division Western Regional Office, Cascadia Field Station, and Washington Cooperative Fish and Wildlife Research Unit; USDA's Seattle Forestry Sciences Laboratory; and a Department of Veterans Affairs R&D unit.

- The R&D Management Command is a unit of the Office of Naval Research (ONR) inside DOD. ONR is headquartered in Arlington, Virginia, and provides R&D managers to oversee the extramural R&D programs of the Navy and Marine Corps performed by universities, nonprofit organizations, or for-profit companies. ONR sponsors extramural R&D programs in information, electronics, and surveillance; ocean, atmosphere, and space; engineering, materials, and physical science; human systems; and naval expeditionary warfare. This federal unit annually receives approximately \$652,000 of federal R&D funds to support the in-house management activities of about 14 FTEs.

- The Seattle Laboratory is the headquarters of the Northwest Fisheries Science Center inside DOC's NOAA. The overall center is responsible for providing scientific and technical support for the management, conservation, and development of the Pacific Northwest region's anadromous and marine fishery resources and their habitats. The Seattle Laboratory conducts research on the status of stocks and of fisheries and the specific management needs in habitat conservation, endangered and protected species, aquaculture, and full utilization of harvested fish. This federal unit annually receives approximately \$5.7 million of federal R&D funds and has about 92 FTEs, only a portion of whom are involved in R&D activities. The Seattle Laboratory is also the headquarters of the Alaska Fisheries Science Center. The center is responsible for fisheries research in the coastal oceans off Alaska and the west coast of the United States. The research of the center concentrates on five specific areas: conservation biology, environmental conservation, fishery resource analysis and monitoring, fish ecology, and resource enhancement and utilization technologies. Specific activities of the center include the conduct of field and laboratory research to help conserve and manage the fishery resources of the region in compliance with Magnuson-Stevens Fishery Conservation and Management Act (as amended through 1996). This federal unit annually receives approximately \$19.6 million of federal R&D funds and has about 207 FTEs, only a portion of whom are involved in R&D activities.
- The Pacific Marine Environmental Laboratory is a unit of DOC's NOAA. It conducts research on oceanography, marine meteorology, and related subjects. Specifically, it seeks to improve our understanding of the physical and geochemical processes operating in the world's oceans, to define the forcing functions and the processes driving ocean circulation and the global climate system, and to improve environmental forecasting capabilities and other supporting services for marine commerce and fisheries. This federal unit annually receives ap-

proximately \$13.8 of federal R&D funds and has about 91 FTEs.

- The research ship *Rainier* is a unit of DOC's NOAA that operates along the coastal waters of the Pacific coast of the U.S. and in the coastal waters of Alaska. It conducts hydrographic surveys and collects coastal assessment data in support of nautical charting. Specific research activities of this unit emphasize the gathering of the precise measurements and observations needed to promote safe navigation and sustain healthy coasts. It also provides days-at-sea for conducting research and supporting programs of significant national interest, including marine environmental quality, safe marine navigation, and the protection of life and property at sea and along the coasts. This federal unit annually receives approximately \$484,300 of federal R&D funds and has about nine FTEs involved to some extent in R&D activities.
- The Western Fisheries Research Center (WFRC) is a unit of DOI's USGS. It conducts research to support the best possible stewardship of the nation's natural resources, emphasizing fish populations and aquatic ecosystems of the west. Research at this center has provided critical research findings to managers of fish and aquatic resources in the west. Technologies and methods developed by WFRC scientists are in wide use at hatcheries and are applied to conservation of imperiled wild fish populations. Specific research activities of this unit include fish health, fish ecology, and aquatic ecosystems. The WFRC maintains facilities at five permanent locations and two or more seasonal sites. Three of the five facilities are in Washington—the Seattle Laboratory, the Columbia River Research Laboratory, and the Marrowstone Marine Field Station. The other two facilities—the Dixon Duty Station and the Reno Field Laboratory—are in California and Nevada, respectively. This federal R&D unit annually receives approximately \$586,000 of federal R&D funds and has about 27 FTEs.

- The Biological Resources Division Western Regional Office inside DOI's USGS has direct line authority over the five science centers in its region. The office coordinates science and operational activities among the Western Region's centers and integrates with the Eastern and Central Regions. The office also provides research expertise to other DOI bureaus and coordinates and integrates this activity within DOI as well. This federal R&D unit annually receives approximately \$625,000 of federal R&D funds and has about six FTEs.
- The Cascadia Field Station, known formerly as the University of Washington Field Station, is a unit of the Forest and Rangeland Ecosystem Science Center inside DOI's USGS. It conducts research on the biological and social aspects of resource management issues in national parks and other protected areas on public lands throughout the northwest and beyond. It also directs several long-term studies and assists federal agencies with scientific issues of immediate concern to resource management. The two major program of the unit, biology and social science, address various aspects of natural and human resource issues that occur in national parks and other public lands. This federal R&D unit annually receives approximately \$229,000 of federal R&D funds and employs about three people.
- The Washington Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of the University of Washington. It conducts research on management of aquatic habitats for shellfish and warm- and cold-water fish, including anadromous salmonids. Specific research activities of this unit include studies of the requirements of individual species, the effects of habitat alterations (physical and chemical) on populations and communities, and fish/wildlife interactions. The unit's wildlife research focuses on the habitat requirements of individual species as well as the aquatic wildlife within crop and forest lands, and wildlife in near-coastal communities. This federal R&D unit annually receives approximately \$178,000 of federal R&D funds and has about two FTEs.

- The Seattle Forestry Sciences Laboratory is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. It conducts research to improve the accuracy of terrain and vegetation measurements, understand the structural change in rural communities' economies that are dependent on natural resources, and integrate and evaluate how people relate to forests. Specific research activities of this laboratory include landscape planning to help scientists and the public visualize what stands and landscapes would look like under certain patterns of tree removal and the development of models for air pollutant emissions that enable managers in the West to compare alternatives to achieve the best ecological effect of fire with the least risk of air pollution. This federal R&D unit annually receives approximately \$2.3 million of federal R&D funds and has about 30 employees.
- While the principal focus of the VA Puget Sound Health Care System facility, the VA Medical Center in Seattle, is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 454 projects with total funding of approximately \$10 million. These R&D activities focus on a wide range of topics, including Alzheimer's disease, diabetes, dementia, aging, depression, and spinal cord injuries.

Spokane, Washington, is home to HHS's Spokane Research Center.

- The Spokane Research Center is a unit of the National Institute for Occupational Safety and Health inside HHS's Centers for Disease Control and Prevention (CDC). It conducts research to prevent injuries and fatalities related to vertical movement of personnel and materials in mine shafts and ore passes. Specific research activities of this lab include developing ways to improve monitoring, inspection, and operating procedures; increasing awareness of the proper functioning of mine hoists, ore passes, and chutes; developing means of warning of potentially dangerous situations; and studying ways to improve the design of

mine shaft and ore pass structures. This federal R&D unit annually receives approximately \$6.6 million of federal R&D funds and has about 65 FTEs.

Tacoma, Washington, is home to DOI's Washington District Office of Water Resources.

- The Washington District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$3.6 million in federal R&D funds.

Wenatchee, Washington, is home to USDA's Tree Fruit Research Laboratory and the Wenatchee Forestry Sciences Laboratory.

- The Tree Fruit Research Laboratory is a unit of USDA's ARS located on the campus of Washington State University. It conducts basic and applied research that is regional, national, and international in scope, which will ensure the long-term competitiveness of the tree fruit industry in domestic and international markets. Specific research activities of this lab include the development of new methods and technologies for the identification, detection, management, and control of pre- and posthar-

vest pathogens, diseases, and disorders of tree fruit, including those that are currently controlled by use of methyl bromide as preplant soil fumigant. This federal R&D unit annually receives approximately \$1.4 million of federal R&D funds and has about 25 FTEs.

- The Wenatchee Forestry Sciences Laboratory is a unit of the Pacific Northwest Research Station inside USDA's Forest Service. It is on the campuses of Washington State University and the University of Washington. It conducts research on protecting and restoring forest health, resource sustainability, and biodiversity with an emphasis on a landscape approach. In addition to insects and diseases, fire as a natural disturbance is emphasized. Specific research activities of this laboratory include approaches to restore damaged landscapes and to develop future vegetation patterns that will be more resilient in the face of natural and human-caused disturbances. This federal R&D unit annually receives approximately \$1.3 million of federal R&D funds and has about 20 employees.

Yakima, Washington, is home to USDA's Yakima Agricultural Research Laboratory.

- The Yakima Agricultural Research Laboratory is a unit of USDA's ARS. It conducts research on a wide variety of insect problems affecting fruit and vegetable production and marketing. Specific research activities of this unit include developing a conceptual plan for implementing an areawide pest management program for pome fruits in the western United States with emphasis on replacing broad-spectrum insecticides with selective, environmentally friendly control tactics, and developing methods for efficiently combining biological and plant resistance to manage insect pests in potatoes. This federal R&D unit annually receives approximately \$4.2 million of federal R&D funds and has about 72 FTEs.

FEDERAL R&D GRANTS TO WASHINGTON ENTITIES

Every major institution of higher education in Washington is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, DOD, and DOE to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Washington, Washington State University (WSU), and Western Washington University (WWU). The table below shows the number of R&D grants active in FY 1998, highlighting those made by HHS, NSF, DOD, and DOE to parties at the various institutions and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Washington are ones from NASA (\$8 million), DOC (\$5 million), EPA (\$4 million), and USDA (\$3 million). The comparable grants going to WSU include \$7 million from USDA, with most of the remainder coming from NASA and EPA.

Table 49.1 – Sources of Federal R&D Grants to Higher Education in Washington

Institution	HHS		NSF		DOD		DOE		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Wash	\$242M	958	\$33M	487	\$18M	123	\$12M	49	\$21M	244	\$326M	1,861
WSU	\$12M	100	\$5M	101	\$2M	21	\$5M	33	\$8M	376	\$32M	631
WWU	<\$1M	2	\$1M	22	\$1M	1	0	0	0	0	\$2M	25
Other	<\$1M	4	\$1M	29	<\$1M	2	0	0	\$1M	17	\$2M	52
Total	\$254M	1,064	\$40M	639	\$21M	147	\$17M	82	\$30M	637	\$362M	2,569

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions, such as the Physics Department at the University of Washington.

Several other nonacademic institutions in Washington also receive a significant amount of federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Fred Hutchinson Cancer Research Center in Seattle (\$104 million), the Seattle Biomedical Research Institute (\$5 million), Mathsoft, Inc., in Seattle (\$3 million), Group Health Cooperative of Puget Sound in Seattle (\$3 million), and Children's Orthopedic Hospital and Medical Center in Seattle (\$3 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Washington received 110 SBIR awards totaling \$29 million. Examples include a \$600,000 award from DOD (Air Force) to Microvision, Inc., in Seattle to develop wide field of view display technology for C4I applications and a \$700,000 award from HHS to Progenesis, Inc., in Mercer Island for work on a triggered suggestion device to treat nicotine dependence.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Washington are ones valued at more than \$4 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Washington every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN WASHINGTON

Several entities in Washington also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. By far the majority of the funds go from DOD to the Boeing Company, which in FY 1998 received close to \$796 million in R&D contracts for work on such efforts as the Joint Strike Fighter Program and the Airborne Laser (ABL) weapon system. In addition, the Fred Hutchinson Cancer Research Center (\$25 million), Battelle Memorial Institute (\$18 million), Alliant Techsystems, Inc. (\$8 million), and Northwest Research Associates (\$4 million) received large R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants also received by the Fred Hutchinson Cancer Research Center. The University of Washington (\$14 million) and WSU (\$4 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$24 million of federal R&D dollars was also received in FY 1998 by entities located in Washington in the form of cooperative agreements. The largest of these cooperative agreements (\$6 million in FY 1998) came from DOC to the University of Washington to operate the Joint Institute for the Study of Atmosphere and Ocean (JISAO). Other federal agencies awarding cooperative agreements to Washington-based entities include the Department of Justice, DOD, DOE, and NSF. Among these latter cooperative agreements is an award supporting one of NSF's Science and Technology Centers—the Center for Molecular Biotechnology at the University of Washington.

Chapter 50

Federal Research and Development in West Virginia

- Approximately \$261 million of federal R&D funds are spent each year in West Virginia.
- West Virginia ranks 34th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 7 percent of all federal funds spent in West Virginia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

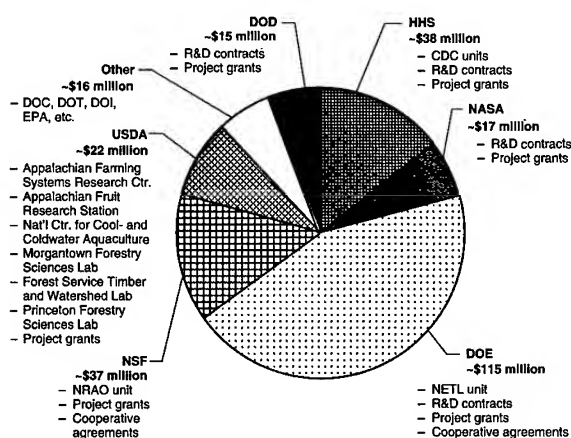


Figure 50.1 – Sources of Federal R&D Dollars Spent in West Virginia
(Total Federal R&D ~\$261 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$261 million annually in West Virginia on research and development (R&D) activities. On average, federal R&D dollars account for approximately 7 percent of all federal funds spent in West Virginia each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in West Virginia. Foremost among these agencies is the Department of Energy (DOE), which accounts for 44 percent of all federal R&D dollars spent in the state. The Department of Health and Human Services (HHS), the National Science Foundation (NSF), and the Department of Agriculture (USDA) account for an additional 15, 14, and 9 percent of the federal R&D dollars spent in West Virginia, respectively. The Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA) each account for an additional 6 percent of the federal R&D dollars spent in the state. The remaining federal R&D dollars come collectively from the Department of Transportation (DOT) and several other federal agencies.⁵⁰

All federal R&D dollars spent in West Virginia either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in West Virginia.

FEDERAL R&D UNITS IN WEST VIRGINIA

Beckley, West Virginia, is home to USDA's Appalachian Farming Systems Research Center.

- The Appalachian Farming Systems Research Center, formerly the Appalachian Soil and Water Conservation Laboratory, is a

⁵⁰ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

unit of USDA's Agricultural Research Service (ARS). The center conducts research on soil quality, forage and grazing management, the ecology of underutilized or marginal land, and silvo-pastoral and understory crop production systems. Specific research activities of the center include studies on the utilization of woodlots in traditional pasture systems as a means to modify the distribution and quality of forage resources. Other research activities include identifying soil physical and biophysical properties that are sensitive indicators of soil quality in grazed systems. This federal R&D unit annually receives approximately \$4.6 million in federal R&D funds and has about 62 FTEs.

Charleston, West Virginia, is home to the Department of Interior's (DOI's) West Virginia District Office of Water Resources.

- The West Virginia District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$993,000 in federal R&D funds.

Clarksburg, West Virginia, is home to a Department of Veterans Affairs (DVA) R&D unit.

- While the principal focus of the Louis A. Johnson VA Medical Center in Clarksburg is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 11 projects with total funding of less than \$25,000. These R&D activities focus on a wide range of topics, including posttraumatic stress disorder, prostate cancer, heart disease, diabetes, and kidney disease.

Green Bank, West Virginia, is home to a portion of NSF's National Radio Astronomy Observatory.

- The National Radio Astronomy Observatory (NRAO) is a federally funded research and development center (FFRDC) sponsored by the National Science Foundation and operated by Associated Universities, Inc. It is headquartered in Charlottesville, Virginia, with observing sites in Green Bank, West Virginia; Tucson, Arizona; and Socorro, New Mexico. NRAO was established to ensure that all qualified scientists have access to radio astronomy facilities. The Green Bank site is home to the Green Bank Telescope, which is a 100-meter telescope that allows spectral lines to be studied at centimeter wavelengths. Each year, the four sites of this federally owned and consortium-operated unit collectively receive approximately \$44 million of federal R&D funds to conduct operations. The Green Bank site annually receives approximately \$21 million of federal R&D funds and has about 85 employees. A substantial portion of these funds is spent on the maintenance and operation of R&D equipment and facilities.

Huntington, West Virginia, is home to a DVA R&D unit.

- While the principal focus of the Huntington VA Medical Center is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 34 projects with total funding of approximately \$80,000. These R&D activities focus on a wide range of topics, including diabetes, pneumonia, bronchitis, and hepatitis.

Kearneysville, West Virginia, is home to USDA's Appalachian Fruit Research Station and DOI's Biological Resources Division Eastern Regional Office.

- The Appalachian Fruit Research Station, a unit of USDA's ARS, consists of two research divisions—the Breeding and Biotechnology Research Unit and the Production and Storage Unit. This research station conducts research on the critical problems of temperate fruit production. Specific research activities of this station include studies to maximize productivity and quality of fruit crops and minimize the adverse effects of biotic and environmental factors on these crops. This federal R&D unit receives approximately \$6.3 million in federal R&D funds and has about 63 FTEs.
- The Biological Resources Division Eastern Regional Office inside DOI's USGS has direct line authority over the six science centers in its region. The office coordinates science and operational activities among the Eastern Region's centers and integrates with the Western and Central Regions. The office also provides research expertise to other DOI bureaus and coordinates and integrates this activity within DOI as well. In addition, a cooperative unit coordinator/eastern supervisor is located in Kearneysville. Altogether, this federal R&D unit annually receives approximately \$611,000 of federal R&D funds and has about eight FTEs.

Leetown, West Virginia, is home to DOI's Leetown Science Center and the USDA's National Center for Cool and Cold Water Aquaculture.

- The Leetown Science Center is a unit of DOI's USGS. Leetown has additional research units located in Wellsboro, Pennsylvania, and Turners Falls, Massachusetts. It conducts research on high-priority needs of aquatic resource managers and public policymakers regarding fishery research. Specific research activities of this unit include studying the behavioral ecology of migrating fish impacted by dams and barriers, pollution, and human development; developing methods for detecting, controlling, and

preventing diseases; and investigating the effects of environmental factors on the physiology, pathology, biochemistry, behavior, and ecology of aquatic organisms. This federal R&D unit annually receives approximately \$2.7 million of federal R&D funds and has about 53 FTEs.

- The National Center for Cool and Cold Water Aquaculture is a unit of USDA's ARS. It conducts research on the organismic, cellular, and molecular levels of gene expression to improve cool- and cold-water aquaculture species. Specific research activities of the center include identifying and evaluating the genetic and the physiological factors that control complex traits important to production and identifying and genetically characterizing phenotypic variation in economically important traits, such as growth, disease resistance, reproductive performance, and response to stress. This federal R&D unit annually receives approximately \$223,000 in federal R&D funds and has one FTE.

Morgantown, West Virginia, is home to HHS's Division of Safety Research, Division of Respiratory Disease Studies, and Health Effects Laboratory; DOE's National Energy Technology Laboratory—Morgantown; DOI's West Virginia Cooperative Fish and Wildlife Research Unit; and USDA's Morgantown Forestry Science Laboratory.

- The Division of Safety Research, the Division of Respiratory Disease Studies, and the Health Effects Laboratory Division are units of the National Institute of Occupational Safety and Health (NIOSH) inside HHS's Centers for Disease Control and Prevention (CDC). They conduct research on occupational-injury and public health activities directed toward prevention of occupational respiratory diseases. Specific research focus areas include agriculture, asthma, construction, fibers, mining, and surveillance. The units also perform research to identify and control harmful workplace agents and to help identify early detection of occupational diseases. These federal R&D units combined annually receive approximately \$36.1 million of federal R&D funds and have about 369 FTEs.

- The National Energy Technology Laboratory–Morgantown, formerly a part of the Federal Energy Technology Center, is a unit of DOE. It is affiliated with the National Energy Technology Laboratory–Pittsburgh in Pennsylvania. It develops technologies related to coal, oil, and natural gas (i.e., fossil energy), and environmental cleanup. Specifically, the laboratory conducts research on fuel gas reaction engineering, CO₂ sequestration, and steady low-flow nitrous oxide combustion. While the laboratory maintains a modest in-house R&D capability, most of its staff oversees extramural R&D projects conducted with federal R&D funds. This federal laboratory annually receives approximately \$259 million of total funds, only about \$32 million of which is spent on R&D activities conducted on site. The laboratory has about 407 employees.
- The West Virginia Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of West Virginia University. It conducts research on environmental impacts on the ecosystem. Specific research activities of this unit include investigating the effects of timber harvesting on birds, studying wildlife in early successional habitats, and looking into the effects of acidic waters on aquatic species. This federal R&D unit annually receives approximately \$155,000 of federal R&D funds and has about two FTEs.
- The Morgantown Forestry Sciences Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on harvesting strategies and on disturbance ecology and management of oak-dominated forests. Specific research activities of this lab includes studying the changes in ecological processes brought on by disturbances by the gypsy moth, developing effective silvicultural treatments for rehabilitating and regenerating oak forests, and evaluating alternative harvesting strategies for all forested geographic regions in the northeastern United States. This federal R&D unit annually receives approximately \$1.8 million in federal R&D funds and has about 14 employees.

Parsons, West Virginia, is home to USDA's Forest Service Timber and Watershed Laboratory.

- The Timber and Watershed Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research into sustaining forest ecosystems in the central Appalachians. Specific research activities of this lab include studying the historical disturbance patterns and influences on ecosystem processes and investigating silvicultural alternatives for meeting complex management objectives. This federal R&D unit annually receives approximately \$1.7 million in federal R&D funds and has about 21 employees.

Princeton, West Virginia, is home to USDA's Forest Service's Forestry Sciences Laboratory.

- The Princeton Forestry Sciences Laboratory is a unit of the Northeastern Research Station inside USDA's Forest Service. It conducts research on silvicultural systems and forest operations. Specific research activities of this lab include developing estimates of primary and secondary hardwood product production and consumption activities and analyzing factors and events that could alter these patterns. Also, the unit conducts an analysis on the structure, conduct, and performance of hardwood products industries. This federal R&D unit annually receives approximately \$2.2 million in federal R&D dollars and has about 19 employees.

FEDERAL R&D GRANTS TO WEST VIRGINIA ENTITIES

Every major institution of higher education in West Virginia is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, DOD, NSF, and USDA to individual faculty members and therefore ultimately inure to the benefit of such institutions as West Virginia University (WVU) and Marshall University. The table below shows the

number of R&D grants active in FY 1998, highlighting those made by HHS, DOD, NSF, and USDA to parties at these institutions and estimates of the total dollars transferred to them pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category going to WVU are from NASA and DOE.

Table 50.1 – Sources of Federal R&D Grants to Higher Education in West Virginia

	HHS		DOD		NSF		USDA		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
WVU	\$9M	55	<\$1M	2	\$3M	40	\$3M	74	\$1M	29	\$17M	200
Marshall	\$1M	11	\$4M	2	<\$1M	4	<\$1M	1	<\$1M	1	\$5M	19
Other	<\$1M	3	0	0	<\$1M	2	0	0	<\$1M	1	<\$1M	6
Total	\$10M	69	\$4M	4	\$3M	46	\$3M	75	\$1M	31	\$22M	225

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in West Virginia also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Canaan Valley Institute in Davis (\$6 million), the State of West Virginia (\$1 million), and the West Virginia State Department of Health and Human Resource (\$1 million) in Charleston.

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in West Virginia received five SBIR awards totaling close to \$500,000. Examples include a \$100,000 award from DOD (Air Force) to Touchstone Research Labs, Ltd., in Triadelphia for work on

brazed aluminum ribbon composite materials for cryogenic tanks and a \$100,000 award from OSD to Azimuth, Inc. in Morgantown to develop a small craft vision enhancement and situation awareness system.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting West Virginia are ones valued at more than \$2.7 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in West Virginia every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN WEST VIRGINIA

Several entities in West Virginia also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The majority of these funds go to Bombardier Services Corp., which in FY 1998 received close to \$6 million from DOD (Navy) for work on the Vertical Takeoff and Landing Unmanned Aerial Vehicle Flight Test Demonstration program. In addition, the West Virginia Department of Health and Human Resource (\$1.5 million) and Alliant Techsystems, Inc. (\$600,000), received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants received by the West Virginia Department of Health and Human Resource. WVU (\$1 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$431 million of federal R&D dollars was also received in FY 1998 by entities located in West Virginia in the form of cooper-

ative agreements. The largest of these cooperative agreements (\$96 million in FY 1998) came from DOE to a team of performers connected to the National Energy Technology Laboratory–Morgantown for work on the McIntosh Unit 4B Demonstration Project in Florida. Other federal agencies awarding cooperative agreements to West Virginia–based entities include NSF and the Department of Justice.

Chapter 51

Federal Research and Development in Wisconsin

- Approximately \$376 million of federal R&D funds are spent each year in Wisconsin.
- Wisconsin ranks 29th among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 5 percent of all federal funds spent in Wisconsin each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

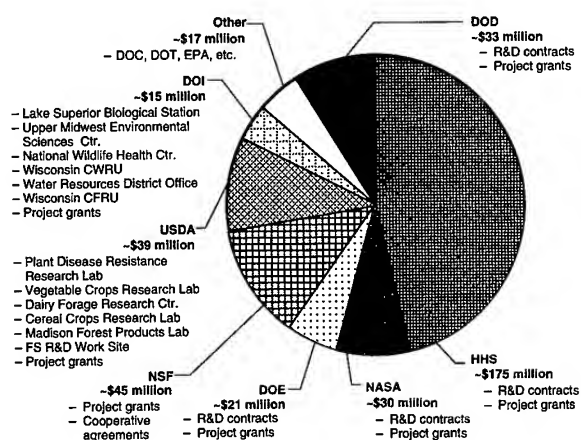


Figure 51.1 – Sources of Federal R&D Dollars Spent in Wisconsin
(Total Federal R&D ~\$376 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$376 million annually in Wisconsin on research and development (R&D) activities. On average, federal R&D dollars account for approximately 5 percent of all federal funds spent in Wisconsin each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Wisconsin. Foremost among these agencies is the Department of Health and Human Services (HHS), which accounts for 46 percent of all federal R&D dollars spent in the state. The National Science Foundation (NSF), the Department of Agriculture (USDA), the Department of Defense (DOD), and the National Aeronautics and Space Administration (NASA) account for an additional 12, 10, 9, and 8 percent of the federal R&D dollars spent in Wisconsin, respectively. The Department of Energy (DOE) and the Department of Interior (DOI) account for an additional 6 and 4 percent, respectively. The remaining federal R&D dollars come collectively from the Departments of Commerce (DOC) and Transportation (DOT) and several other federal agencies.⁵¹

All federal R&D dollars spent in Wisconsin either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Wisconsin.

FEDERAL R&D UNITS IN WISCONSIN

Ashland, Wisconsin, is home to DOI's Lake Superior Biological Station.

- The Lake Superior Biological Station is a unit of the Great Lakes Science Center inside DOI's U.S. Geological Survey (USGS). It conducts research on biology, population dynamics,

⁵¹ For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

stock delineation, and yield prediction of Lake Superior fish with an emphasis on lake trout, lake herring, and other forage fishes. Specific research activities of this unit include studies of the ecological effects of invading ruffe on native species and ecosystems. This federal R&D unit annually receives approximately \$486,000 of federal R&D funds and has about six FTEs.

La Crosse, Wisconsin, is home to DOI's Upper Midwest Environmental Sciences Center.

- The Upper Midwest Environmental Sciences Center is a unit of DOI's USGS. It conducts research on biological, physical, spatial, and technical data and information relating to the Upper Mississippi River System. Specific research activities of this unit include studies of aquatic ecology, migratory birds, fishery drug R&D, declining and endangered species, and environmental contaminants. This federal R&D unit annually receives approximately \$2.1 million of federal R&D funds and has about 48 FTEs.

Madison, Wisconsin, is home to DOI's National Wildlife Health Center and Wisconsin Cooperative Wildlife Research Unit; USDA's Plant Disease Resistance Research Laboratory, Vegetable Crops Research Laboratory, U.S. Dairy Forage Research Center, Cereal Crops Research Unit, and Madison Forest Products Laboratory; and a Department of Veterans Affairs (DVA) R&D unit.

- The National Wildlife Health Center is a unit of DOI's USGS. It conducts research to assess the impact of disease on wildlife and identifies the role of various pathogens in contributing to wildlife losses. Specific research activities of this unit include such areas as the ecological relationships leading to disease, disease prevention and control, and reducing wildlife losses when outbreaks occur. This federal R&D unit annually receives approximately \$2.8 million of federal R&D funds and has about 58 FTEs.
- The Wisconsin Cooperative Wildlife Research Unit is part of DOI's USGS. It is on the campus of the University of Wisconsin,

Madison. It conducts research on problems related to wildlife and their habitats. Specific research activities of this unit include studies of ruffed grouse, Canada geese, bobwhite quail, agricultural ecosystems, management of biodiversity on military lands, and rails of Wisconsin. This federal R&D unit annually receives approximately \$193,000 of federal R&D funds and has about two FTEs.

- The Plant Disease Resistance Research Laboratory is a unit of USDA's Agricultural Research Service (ARS) located on the campus of the University of Wisconsin. It conducts research on interactions between disease-causing agents and their host plants that define resistance and susceptibility. Results of this research are used to provide practical solutions to problems of disease resistance. This federal R&D unit, in combination with the Cereal Crops Research Unit, the U.S. Dairy Forage Research Center, and the Vegetable Crops Research Center described below, annually receives approximately \$6.2 million of federal R&D funds and has about 61 FTEs.
- The Vegetable Crops Research Laboratory is also a unit of USDA's ARS located on the campus of the University of Wisconsin. It conducts research on the genetics, cytology, cytogenetics, and breeding strategies of vegetable crops. These studies focus on chromosome behavior, phylogeny, pest resistance, intra- and interspecific crossing, nutritional quality, flavor storage quality, and effects of environmental stress of *Solanum* species, carrot, cucumber, and onion. Specific research activities of this laboratory include the use of exotic germplasm, germplasm enhancement, and development of production technologies. The funding and staffing information for this federal R&D unit are included in those presented immediately above for the Plant Disease Resistance Research Laboratory.
- The U.S. Dairy Forage Research Center is also a unit of USDA's ARS located on the campus of the University of Wisconsin. It conducts research on problems related to the production and

utilization of forages by dairy cattle. Specific research activities at this center include the following topics: understanding chemical structure and improving digestibility of the forage cell wall, improving the utilization of forage protein, development of a comprehensive computer simulation of the dairy production system, and improving forage harvesting methods through engineering research. The funding and staffing information for this federal R&D unit are included in those presented for the Plant Disease Resistance Research Laboratory described above.

- The Cereal Crops Research Unit is also a unit of USDA's ARS located on the campus of the University of Wisconsin. It conducts research on biological and biochemical mechanisms in cereal plants that affect the properties of their grain products. Specific research activities at this unit include the development of information on the basic growth and metabolic processes of cereal plants, application of findings to improve cereal quality through enhanced germplasm or altered production practices, and providing support for applied oat and barley research and breeding programs in ARS and State Agricultural Experiment Stations. The funding and staffing information for this federal R&D unit are included in those presented for the Plant Disease Resistance Research Laboratory described above.
- The Madison Forests Products Laboratory is a unit of USDA's Forest Service. The research focus of this laboratory is on pulp and paper products, housing and structural uses of wood, wood preservation, wood and fungi identification, and finishing and restoration of wood products. In addition to traditional lines of research, the laboratory uses cutting-edge techniques to study recycling, develop environmentally friendly technology, and understand ecosystem-based forest management. This federal R&D unit annually receives approximately \$17.1 million in federal R&D funds and has about 246 FTEs.
- While the principal focus of the William S. Middleton VA Medical Center in Madison is providing medical care to veterans, it

is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 246 projects with total funding of approximately \$1.2 million. These R&D activities focus on a wide range of topics, including pharmacokinetics, aging, magnetic resonance imaging, and hypertension.

Middleton, Wisconsin, is home to DOI's Wisconsin District Office of Water Resources.

- The Wisconsin District Office of Water Resources is a unit of DOI's USGS. It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.8 million in federal R&D funds.

Milwaukee, Wisconsin, is home to a DVA R&D unit.

- While the principal focus of the Clement J. Zablocki VA Medical Center in Milwaukee is providing medical care to veterans, it is also the location of a number of research activities. In a recent year, this federally owned and operated facility was the site of 401 projects with total funding of approximately \$3 million. These R&D activities focus on a wide range of topics, including radiotherapy, hypertension, neoplasms, and spinal cord injuries.

Rhineland, Wisconsin, is home to a USDA Forest Service R&D Work Site.

- The R&D Work Site is a unit of the North Central Forest Experiment Station inside USDA's Forest Service. It conducts research on climatic influences on forest ecosystems, landscape ecology and forest genetics. Specific research activities of this unit include studying how trees respond physiologically to stress caused by climatic change, identifying and characterizing certain genes in forests that protect trees from damaging physical and biological agents, and studying factors that influence biodiversity. This federal R&D unit annually receives approximately \$2.8 million in federal R&D funds and has about 23 employees.

Stevens Point, Wisconsin, is home to DOI's Wisconsin Cooperative Fishery Research Unit.

- The Wisconsin Cooperative Fishery Research Unit is part of DOI's USGS. It is on the campus of the University of Wisconsin, Stevens Point. It conducts research on fisheries and aquatic fauna. Specific research activities of this unit include studying how ecosystem processes are altered by anthropogenic activities and includes multidisciplinary projects assessing linkages between aquatic and terrestrial environments. This federal R&D unit annually receives approximately \$96,000 of federal R&D funds and has one FTE.

FEDERAL R&D GRANTS TO WISCONSIN ENTITIES

Every major institution of higher education in Wisconsin is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by HHS, NSF, and DOE to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Wisconsin, the Medical College of Wisconsin (MCW), and Marquette University. The table below shows the number of R&D grants active in FY 1998,

highlighting those made by HHS, NSF, and DOE to parties at these institutions and estimates of the total dollars transferred to them pursuant to the terms of these grants. Among the grants in the "Other Agencies" category going to the University of Wisconsin are ones from USDA (\$8.5 million), DOD (\$8 million), and NASA (\$6.5 million), plus \$2 million each from DOC and the Department of Education. Most of the comparable grants going to Marquette University are from EPA, while those to MCW come from at least five different agencies.

Table 51.1 – Sources of Federal R&D Grants to Higher Education in Wisconsin

Institution	HHS		NSF		DOE		Other Agencies		Total	
	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Wisconsin	\$136M	702	\$35M	514	\$18M	73	\$29M	537	\$218M	1,826
MCW	\$43M	200	<\$1M	4	0	0	\$1M	9	\$44M	213
Marquette	\$1M	25	<\$1M	10	<\$1M	2	\$1M	12	\$2M	49
Other	\$1M	9	<\$1M	10	<\$1M	1	<\$1M	7	\$1M	27
Total	\$181M	936	\$35M	538	\$18M	76	\$30M	565	\$265M	2,115

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Several other nonacademic institutions in Wisconsin also receive federal R&D grants each year. Foremost among the institutions that received R&D grants in FY 1998 are the Marshfield Clinic in Marshfield (\$4 million), the Blood Center of Southeastern Wisconsin in Milwaukee (\$3 million), Contemporary Products in Milwaukee (\$1 million), the Wisconsin State Department of Public Welfare (\$1 million), and Promega Corp. (\$1 million).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research

(SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extramural R&D of more than \$100 million. In a recent year, small businesses in Wisconsin received 39 SBIR awards totaling close to \$6 million. Examples include a \$700,000 award from HHS to Learning Multi-Systems, Inc., in Madison for work on integrating multimedia into a drug prevention resource and a \$250,000 award from USDA to Micro-grain, Inc., in Clinton to study microwave radiation as a pesticide alternative for stored products.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Wisconsin are ones valued at more than \$5.1 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Wisconsin every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN WISCONSIN

Several entities in Wisconsin also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. The largest of these contracts goes to Marshfield Clinic, which in FY 1998 received close to \$4 million from HHS in support of the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial. In addition, Rayovac Corp. (\$3 million), the Wisconsin Department of Public Welfare (\$2 million), Orbital Technologies Corp. (\$2 million), and TN Associates, Inc. (\$1 million), received significant R&D contracts from federal agencies in FY 1998. Note that these amounts are in addition to the federal R&D grants received by Marshfield Clinic and the Wisconsin Department of Public Welfare. The Uni-

versity of Wisconsin (\$5 million) and MCW (\$3 million) also received contracts from various federal agencies to conduct R&D for the federal government. Although these amounts are notable, they do not come close to eclipsing the funds that these institutions receive from federal R&D grants.

A total of \$14 million federal R&D dollars was also received in FY 1998 by entities located in Wisconsin in the form of cooperative agreements. The largest of these cooperative agreements (\$2 million in FY 1998) came from NSF to the University of Wisconsin in Madison to operate the Materials Research Science and Engineering Center (MRSEC) on Nanostructured Materials and Interfaces. Other federal agencies awarding cooperative agreements to Wisconsin-based entities include DOC and DOE.

Chapter 52

Federal Research and Development in Wyoming

- Approximately \$41 million of federal R&D funds are spent each year in Wyoming.
- Wyoming ranks 51st among the 50 states, District of Columbia, and Puerto Rico in terms of the amount of federal R&D dollars received annually.
- Approximately 3 percent of all federal funds spent in Wyoming each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance) is spent on R&D.

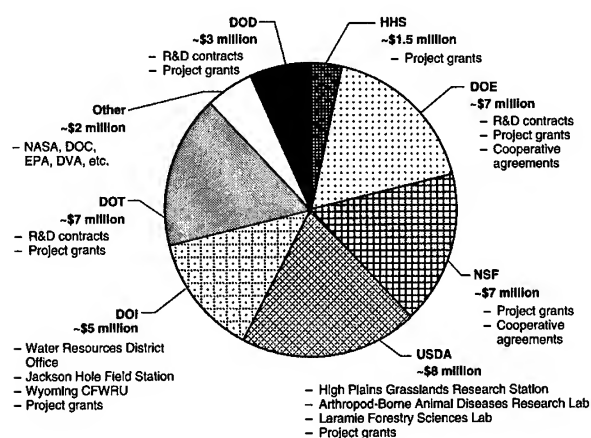


Figure 52.1 – Sources of Federal R&D Dollars Spent in Wyoming
(Total Federal R&D ~\$41 million)

BACKGROUND

In recent years, the federal government has spent in the neighborhood of \$41 million annually in Wyoming on research and development (R&D) activities. On average, federal R&D dollars account for approximately 3 percent of all federal funds spent in Wyoming each year on matters other than the direct support of individuals (i.e., such entitlements as retirement, disability, and housing assistance).

Most major federal agencies that currently support federal R&D efforts provide funding for R&D activities in Wyoming. Foremost among these agencies are the Departments of Agriculture (USDA), Energy (DOE), and Transportation (DOT) and the National Science Foundation (NSF), which account for 20, 18, 17, and 17 percent of all federal R&D dollars spent in the state, respectively. The Departments of Defense (DOD) and Health and Human Services (HHS) account for an additional 7 and 4 percent of the federal R&D dollars spent in Wyoming, respectively. The remaining federal R&D dollars come collectively from the National Aeronautics and Space Administration (NASA), the Environmental Protection Agency (EPA), and several other federal agencies.⁵²

All federal R&D dollars spent in Wyoming either cover the costs of operating federal R&D units in the state, including paying the salaries of federal R&D personnel working at these units, or are awarded as grants, contracts, or cooperative agreements to entities in the state. The following is an overview of what becomes of these federal R&D dollars once they arrive in Wyoming.

FEDERAL R&D UNITS IN WYOMING

Cheyenne, Wyoming, is home to USDA's High Plains Grasslands Research Station and the Department of Interior's (DOI's) Wyoming District Office of Water Resources.

- The High Plains Grasslands Research Station is part of USDA's Agricultural Resources Service (ARS). It conducts research on

⁵² For a complete agency-by-agency breakdown of these R&D dollars, see Appendix C.

grazingland soils, livestock, and vegetation. Specific research activities of the unit focus on such areas as soil loss through erosion, reclaiming of mined lands, and the impact of livestock on grasslands. This federal R&D unit annually receives approximately \$1.8 million of federal R&D funds and has about 25 FTEs.

- The Wyoming District Office of Water Resources is a unit of DOI's U.S. Geological Survey (USGS). It oversees the R&D activities of USGS's National Water-Quality Assessment (NAWQA), Ground-Water Resources Assessment, Toxic Substances Hydrology, and Federal State Cooperatives programs. The NAWQA program conducts research on the nation's surface and groundwater resources to better understand the effect of pesticides, erosion, and bacterial contamination on water quality. The Ground-Water Resources Assessment program studies groundwater systems to develop models and simulations to better understand the workings of these systems. The Toxic Substances Hydrology program studies the behavior of toxic substances in hydrologic environments. These research activities investigate subsurface contamination at local releases and aquatic ecosystem contamination on a watershed and regional scale. The Federal State Cooperatives program studies the effects of agricultural chemicals, floods, droughts, and waste disposal on water supply and groundwater quality. This federal unit annually receives approximately \$1.2 million in federal R&D funds.

Jackson Hole, Wyoming, is home to DOI's Jackson Hole Field Station.

- The Jackson Field Research Station is a unit of the Columbia Environmental Research Center inside DOI's USGS. It conducts research on the influences of mining operations, energy exploration, energy development and production, acid deposition, and metals on fisheries and aquatic ecosystem health. Specific research activities of this unit include such areas as the effect of humans on greater Yellowstone ecosystem water quality, deep-shaft mine waste, and river contamination from ore deposits.

This federal R&D unit annually receives approximately \$145,000 of federal R&D funds and has about four FTEs.

Laramie, Wyoming, is home to USDA's Arthropod-Borne Animal Diseases Research Laboratory and Laramie Forestry Sciences Lab and DOI's Wyoming Cooperative Fish and Wildlife Research Unit.

- The Arthropod-Borne Animal Diseases Research Laboratory is a unit of USDA's ARS located on the campus of the University of Wyoming. It conducts research on diseases of domestic livestock that are transmitted by arthropods, including insects, ticks, and spiders. Specific research activities of the laboratory focus on such areas as the vectors of arboreal diseases; the genetic diversity and molecular biology of arboviruses; and the epidemiology, control, and pathogenesis of animal arbovirus. This federal R&D unit annually receives approximately \$2 million of federal R&D funds and has about 25 FTEs.
- The Laramie Forestry Science Laboratory is a unit of the Rocky Mountain Research Station inside USDA's Forest Service. It conducts research on how to sustain fish and watershed components of aquatic and riparian ecosystems in the central Rocky Mountains and northern Great Plains. Specific research activities of this unit include investigating the movement of nutrients and chemicals through forested watersheds. This federal R&D unit annually receives approximately \$711,000 of federal R&D funds and has about five employees.
- The Wyoming Cooperative Fish and Wildlife Research Unit is part of DOI's USGS. It is on the campus of the University of Wyoming. It conducts research on a range of topics from evaluating management techniques to developing population estimation models. Specific research activities of this unit include studying the habitats of sage grouse, behavior of black-footed ferrets, predator ecology and management, and salmonids in watersheds and regulated rivers. This federal R&D unit annually receives approximately \$296,000 of federal R&D funds and has about three FTEs.

FEDERAL R&D GRANTS TO WYOMING ENTITIES

Every major institution of higher education in Wyoming is the recipient of significant federal R&D dollars each year through grants made by federal agencies to faculty, graduate students, and research centers. The vast majority of the R&D grants are made by NSF, DOD, USDA, and HHS to individual faculty members and therefore ultimately inure to the benefit of such institutions as the University of Wyoming. The table below shows the number of R&D grants active in FY 1998, highlighting those made by NSF, DOD, USDA, and HHS to parties at this institution and estimates of the total dollars transferred to them in FY 1998 pursuant to the terms of these grants. Most of the grants in the "Other Agencies" category come from NASA and EPA.

Table 52.1 – Sources of Federal R&D Grants to Higher Education in Wyoming

	NSF		DOD		USDA		HHS		Other Agencies		Total	
Institution	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#	Amount	#
U of Wyoming	\$6M	79	\$2M	9	\$2M	52	\$2M	13	\$2M	34	\$14M	187

These activities are particularly significant because they fund much of the "basic research" so critical to expanding our knowledge and understanding of fundamental scientific phenomena. In addition, these funds account for a substantial portion of the dollars available each year to various academic departments within these institutions.

Other nonacademic institutions in Wyoming also receive a significant amount of federal R&D grants each year. Foremost among these institutions are Wyoming Sawmills, Inc., in Sheridan (\$150,000), the County of Unita (\$100,000), Detection Limit, Inc., in Laramie (\$100,000), and Bowen Scientific Products in Laramie (\$100,000).

Scattered among these grants, as well as among the contracts discussed in the section below, are small business innovative research (SBIR) awards. These are special awards made by the SBIR programs supported by the 10 federal agencies with annual budgets for extra-

mural R&D of more than \$100 million. In a recent year, small businesses in Wyoming received seven SBIR awards totaling \$750,000. Examples include a \$225,000 award from USDA to Wyoming Sawmills in Sheridan to study the feasibility of creating structural laminated studs from low-grade lumber and a \$90,000 award from HHS to CC Technology in Laramie for work on the rapid detection of prenatal and neonatal metabolic disorders.

Also included among these grants are formula grants from federal agencies. Formula grants differ from the much more common project grants in that the money transmitted through formula grants is allocated to a state or one of its subdivisions in accordance with a distribution formula prescribed by law or regulation. Among the formula grants benefiting Wyoming are ones valued at more than \$1.5 million from USDA's Cooperative State Research, Education, and Extension Service (CSREES) to State Agricultural Experiment Stations, forestry schools, and veterinary colleges for the support of research in agriculture, forestry, and animal health and disease. Similarly, a modest formula grant goes from DOI's USGS to the Water Resources Research Institute in Wyoming every year to foster research in water and water-related problems.

OTHER FEDERAL R&D ACTIVITIES IN WYOMING

Several entities in Wyoming also receive notable sums in the form of contracts or cooperative agreements from federal agencies for specific R&D efforts. A large portion of these funds go to the Shoshone and Arapaho Tribe, which in FY 1998 received close to \$1.5 million in R&D contracts from HHS for health-related activities. In addition, CHA Corp. (\$400,000) and Global Plastec LLC (\$300,000) also received R&D contracts from federal agencies in FY 1998. The University of Wyoming (\$1 million) also receives contracts from various federal agencies to conduct R&D for the federal government. Although this amount is notable, it does not come close to eclipsing the funds that this institution receives from federal R&D grants.

A total of \$6 million of federal R&D dollars was also received in FY 1998 by entities located in Wyoming in the form of cooperative

agreements. By far the largest of these cooperative agreements (\$2 million in FY 1998) came from DOE to the Western Research Institute in Laramie for work on clean coal technologies. Other federal agencies awarding cooperative agreements to Wyoming-based entities include NSF and DOI.

Appendix A

The RaDiUS Database

RaDiUS, the database of Research and Development in the United States federal government, was developed to support the Science and Technology Policy Institute, a federally funded research and development center (FFRDC) operated by RAND. The institute (formerly known as the Critical Technologies Institute) was established by Congress in 1991 to improve public science and technology (S&T) policy by providing research and analysis to the White House Office of Science and Technology Policy (OSTP) and other government agencies (see 42 USC 6686). OSTP is the organizational and administrative force behind the National Science and Technology Council (NSTC).

Prior to the development of RaDiUS, the only information available on the contents of the federal R&D portfolio was either highly aggregated or very disaggregated and incomplete. For example, at the highly aggregated end of the spectrum is the report by the Office of Management and Budget (OMB) included in the annual Budget of the United States Government. This report comprises a chapter in the "Analytical Perspectives" volume of the federal budget and has been prepared annually beginning with the FY 1996 budget. The dollar amounts it contains are Outlays that do not match the official federal R&D baseline numbers, which are in Budget Authority. These numbers are complemented by a chapter in the main portion of each year's budget, which are in Budget Authority, and which constitute the official federal R&D baseline. Also of a highly aggregated nature is the *Federal Funds for Research and Development* report series compiled and published annually since the 1950s by the National Science Foundation (NSF). The dollar amounts this report presents are Obligations, rather than Budget Authority or Outlays, so they do not match to anything presented in the federal budget.

In contrast, at the very disaggregated end of the spectrum is the Federal Research in Progress (FEDRIP) database that contains detailed information on a small portion of federal R&D activities. This database began in 1946 as the Smithsonian Science Information Exchange and has been maintained by the National Technical Information Service (NTIS) at the Department of Commerce since 1981. FEDRIP contains no information on defense R&D and covers only a portion of civilian R&D, all of which is of uneven currency. Because FEDRIP is a data warehouse, the contents of which are not systematically matched to the baseline of the federal budget, it is not easy to determine precisely how much of the federal R&D portfolio FEDRIP actually tracks. However, a careful comparison of the individual records in FEDRIP and the contents of the federal R&D portfolio indicates that, on an annual basis, FEDRIP contains data on only about one-fourth of all federal R&D activities.

RaDiUS is the first information system that connects the highly aggregated data on federal R&D with the very disaggregated data to provide a complete picture of all federal activities involving the conduct of R&D. Specifically, RaDiUS consists of five interconnected levels of increasingly detailed data on federal R&D. The least-detailed level of RaDiUS contains information on the 24 agencies that control and disseminate all R&D dollars spent by the federal government. The amounts carried in this level of RaDiUS are identical to those presented in the Federal Budget for Basic Research, Applied Research, and Development. These three "stages" of R&D collectively constitute the "Conduct of R&D" and constitute the major portion of the official "baseline" of the federal R&D portfolio. RaDiUS does not track funds spent on the construction and rehabilitation of federal R&D facilities or the purchase of major R&D equipment. When funds for these two activities are combined with those for the conduct of R&D, the result is the total budget for the federal R&D portfolio.

From their arrival at the 24 agencies, the dollars carried in the federal R&D budget that are spent on the "conduct of R&D" are tracked by RaDiUS as they are sequentially dispersed to three levels of successively smaller organizational units within the agencies (Levels 2, 3, and 4 in RaDiUS). The information carried in each of the top four levels of

RaDiUS tracks 100 percent of all federal dollars spent annually on the conduct of R&D. The fifth and most-detailed level of RaDiUS tracks these dollars to their final destination at the universities, laboratories, and centers located throughout the world, both inside and outside the federal government. These are the places where the hundreds of thousands of experiments and analyses actually "purchased" with federal R&D dollars take place. The records of these activities are by far the most difficult to obtain, for they are scattered throughout the federal government in a wide variety of forms and formats. In addition, these records represent the core of agencies' missions, so some are reluctant to share such detailed information with other agencies for fear that they might use it to strategic advantage. RAND's neutrality has clearly been an advantage to getting agencies to make their detailed R&D information available for inclusion in RaDiUS. RAND's in-house technical capabilities have also enabled it to make sense of even the most arcane data records.

To date, over 400,000 such records have been assembled in RaDiUS covering all fiscal years since 1993 and providing vital details on close to 80 percent of the activities in the federal R&D portfolio. More such records are being added to RaDiUS on a regular basis, with the objective of bringing the coverage of the fifth level of RaDiUS as close to 100 percent as soon as possible. Some records in the level are restricted and, while not classified, cannot be accessed freely by everyone. Others are classified and, therefore, cannot be included in the current version of RaDiUS. Still others involve salaries of individual researchers and research managers, which to date have not been a top priority to obtain, because they do not describe specific R&D activities.

The organizing premise of RaDiUS has been to harvest data on federal R&D from information already gathered by the federal government, even if it has not traditionally been viewed as relevant to the tracking of federal R&D activities. For example, RaDiUS includes information from the Federal Assistance Awards Data System (FAADS), which has never before been used to track R&D. The harvested data have then been woven together using common data fields and codes to form a comprehensive picture of federal R&D. Taking this approach to building RaDiUS was essential to ensuring that the Science and Tech-

nology Policy Institute could quickly acquire the broad and flexible data capabilities needed to support OSTP and NSTC. Making RaDiUS easily available to a wide range of users was also a goal. To facilitate this and simultaneously permit valuable but restricted information to be included in the database, RaDiUS was specifically designed to be password-accessible from any personal computer through an encrypted link on the web (<http://www.rand.org/radius>). Each password enables a user to access only those records in RaDiUS that he or she is permitted to view. As a result, RaDiUS makes as much information as possible available to as many people as possible using a single system. To date, more than 30 reports prepared by the institute for OSTP and NSTC have been based in whole or in part on information obtained from RaDiUS. In addition, RaDiUS has been used by federal agencies and contractors to support R&D planning efforts, leverage R&D investments, and transfer technology from discovery sites to places of critical need.

Appendix B

Government-Wide and DOD Definitions of R&D

Definition of R&D					
Government-Wide			DOD-Unique*		
OMB Circular No. A-11 (1998)			DOD Financial Management Regulation (Volume 2B, Chapter 5)		
Conduct of R&D**	Basic Research	Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.	S&T Activities***	Basic Research (6.1)	Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind.
	Applied Research	Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.		Applied Research (6.2)	Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.
	Development	Systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.		Advanced Technology Development (6.3)	Includes all efforts that have moved into the development and integration of hardware for field experiments and tests.
				Demonstration and Validation (6.4)	Includes all efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology.
				Engineering and Manufacturing Development (6.5)	Includes those projects in engineering and manufacturing development for Service use but which have not received approval for full rate production.
				RDT&E Management Support (6.6)	Includes R&D efforts directed toward support of installation or operations required for general R&D use. Included would be test ranges, military construction, maintenance support of laboratories, operations and maintenance of test aircraft and ships, and studies and analyses in support of R&D program.
				Operational System Development (6.7)	Includes those development projects in support of development acquisition programs or upgrades still in engineering and manufacturing development, but which have received Defense Acquisition Board (DAB) or other approval for production, or for which production funds have been included in the DoD budget submission for the budget or subsequent fiscal year.
				Developmental Test and Evaluation	Efforts associated with engineering or support activities to determine the acceptability of a system, subsystem, or component.
Operational Test and Evaluation	Efforts associated with engineering or support activities to determine the acceptability of a system, subsystem, or component.				
R&D Equipment	The acquisition of major equipment for R&D. Includes expendable or movable equipment (e.g., spectrometers, microscopes) and office furniture and equipment. Routine purchases of ordinary office equipment or furniture and fixtures are normally excluded.		No separate definition	Major equipment dollars are mixed with the dollars for the "Conduct of R&D" and carried in the RDT&E accounts (i.e., 6.1 through 6.7) listed above. In FY 1998, DOD requested a total of \$68M for major R&D equipment.	
R&D Facilities	The construction and rehabilitation of R&D facilities. Includes the acquisition, design, and construction of, or major repairs or alterations to, all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the government or by a private organization, and regardless of where title to the property may rest. Includes such fixed facilities as reactors, wind tunnels, and particle reactors. Excludes movable R&D equipment.		No separate definition	In FY 1998, close to 90% of the \$67M requested by DOD for R&D Facilities was carried separately in Military Construction accounts. The rest were included in the costs of major development programs and are mixed with the dollars for the "Conduct of R&D" carried in the RDT&E accounts (i.e., 6.1 through 6.7) listed above.	

* Does not pertain to the Corps of Engineers.

** Includes administrative expenses. Excludes routine product testing, quality control, mapping, collection of general-purpose statistics, experimental production, routine monitoring and evaluation of an operational program, and the training of scientific and technical personnel.

*** Includes costs of laboratory personnel, either in-house or contractor operated.

Appendix C

Derivation of Federal R&D Funding by State

In FY 1998, federal agencies reported \$76.4 billion of budget authority (BA) and \$75.4 billion of outlays (OUT) for R&D activities as part of their official budget submissions to OMB (referred to as OMB BPS "MAX" System Table C.1). Given that budget authority is a better measure of future R&D activities and outlays are a better measure of current R&D activities, the latter is used as the baseline measure of total federal R&D activities for this report. Federal agencies do not provide any detail to OMB, however, on the R&D activities they fund by state.

The only information regularly collected on R&D funds provided by federal agencies to states, be they for grants, contracts, or personnel costs, is gathered by NSF for its *Survey of Federal Funds for Research and Development* (referred to as "Fed Funds" in Table C.1). This information is actually obtained from only 10 of the 24 federal agencies that support R&D and is therefore incomplete. It is also gathered in obligations (OBS) rather than outlays. Furthermore, a close examination of these data also reveals that the R&D amounts reported by each agency by state vary considerably from year to year.

Because the total amount of R&D obligations is reported separately by all 24 federal R&D agencies to NSF, it was possible to estimate the amount of R&D obligations collectively provided each year to states by the other 14 federal agencies not included in NSF's *Survey of Federal Funds for Research and Development*. These estimates were based on the overall proportion of R&D funds received by each state from the 10 federal agencies reporting to NSF and are presented in the "Other Agencies" lines of the attached table. These estimates were combined with the amounts reported by the other 10 federal

agencies to estimate the “real” total federal R&D funds received for FY 1993 through FY 1998 for each state.

In an attempt to obtain the best estimates possible of federal agency R&D funding for each state, the R&D obligation information for FY 1993 through FY 1998 was averaged by federal agency by state. This information is presented in the “Simple Average of TOTALS” column of Table C.1. This average was then used to estimate the outlays made by each federal agency to each state using the \$75.4 billion of R&D outlays reported by federal agencies to OMB as the baseline. These estimated outlays are presented in the “Adjusted Average” column of Table C.1 (see shaded column). It is these estimates that are used throughout the report.

DERIVATION OF FEDERAL R&D FUNDING BY STATE 619

Table C.1—Conduct of R&D and R&D Plant (in thousands)

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS "MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS "MAX" System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97,98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL AL	2,355,070	2,212,069	2,079,914	2,300,445	2,274,665	2,089,334	1,953,659	2,574,394	Estimates.
USDA	17,694	16,620	14,867	20,476	15,855	16,901	16,370	15,250	
DOC	1,503	1,411	610	1,478	2,005	2,025	1,034	1,316	
DOD	1,236,033	1,160,980	1,157,530	1,295,372	1,329,002	1,325,015	844,263	1,014,700	
DOE	63,010	49,792	152,195	34,848	22,487	34,131	19,575	35,514	
HHS	148,118	139,124	164,203	150,216	148,212	129,683	132,044	110,386	
DOI	6,706	6,299	4,662	5,126	4,167	4,085	8,837	10,914	
DOT	2,560	2,405	3,465	1,581	2,170	2,592	3,416	1,203	
EPA	4,404	4,137	4,531	1,733	2,388	4,333	5,810	6,026	
NASA	829,043	778,703	536,888	735,903	692,782	527,024	868,085	1,311,538	
NSF	10,522	9,883	1,421	10,340	9,324	14,554	13,000	10,660	
Other Agencies	45,478	42,715	39,542	43,372	46,273	28,991	41,225	56,887	Estimates.
TOTAL AK	134,858	126,669	112,821	104,906	95,465	99,656	251,249	95,917	Estimates.
USDA	7,658	7,192	7,574	6,989	6,708	7,282	7,793	6,803	
DOC	28,898	27,142	28,027	23,280	34,135	32,625	32,457	12,325	
DOD	16,504	17,381	27,262	28,373	10,150	10,460	15,626	12,412	
DOE	8,548	8,030	50	0	98	302	47,178	552	
HHS	2,781	2,812	2,109	2,600	2,185	2,793	2,911	3,076	
DOI	24,691	23,191	22,129	17,656	24,786	24,531	26,240	23,806	
DOT	1,034	971	1,296	515	697	1,219	1,145	954	
EPA	399	375	290	80	15	1,224	0	642	
NASA	27,586	25,911	12,250	14,096	7,037	8,606	100,534	12,942	
NSF	11,935	11,267	9,718	9,339	7,683	9,234	11,448	20,177	
Other Agencies	2,788	2,598	2,116	1,978	1,971	1,380	5,917	2,228	Estimates.
TOTAL AZ	861,886	809,554	1,012,707	748,036	726,710	971,338	833,352	565,181	Estimates.
USDA	21,882	20,647	22,489	21,731	18,754	20,652	22,281	17,977	
DOC	1,368	1,285	2,059	700	1,064	2,371	1,064	454	
DOD	578,110	543,007	726,497	510,165	478,451	656,967	559,383	326,576	
DOE	5,464	5,133	4,017	3,546	5,825	6,288	5,854	5,265	
HHS	81,367	76,426	84,299	71,280	69,279	83,220	72,564	77,914	
DOI	10,540	9,900	11,984	6,611	8,612	8,995	11,268	11,931	
DOT	2,334	2,193	1,753	913	2,779	3,352	2,855	1,504	
EPA	2,684	2,709	2,512	2,150	5,058	3,066	729	2,737	
NASA	59,570	55,953	56,587	47,927	58,639	69,882	67,360	35,320	
NSF	81,843	76,874	81,060	68,906	63,272	102,972	72,566	72,466	
Other Agencies	16,426	15,429	19,450	14,107	14,977	13,573	17,428	13,037	Estimates.
TOTAL AR	119,604	112,342	117,511	111,949	162,397	103,084	94,728	84,381	Estimates.
USDA	23,284	21,870	26,648	24,967	25,895	18,738	18,149	16,822	
DOC	149	140	388	300	131	23	0	0	
DOD	18,306	17,196	8,420	9,313	68,113	4,201	5,248	7,881	
DOE	165	155	50	22	200	72	304	284	
HHS	63,871	59,993	67,288	65,626	57,764	67,370	55,186	46,723	
DOI	4,842	4,548	4,443	4,060	3,887	3,763	5,194	5,939	
DOT	1,092	1,026	1,405	620	767	1,205	1,252	904	
EPA	602	566	381	732	145	692	1,180	265	
NASA	1,048	985	1,881	350	479	1,667	1,234	296	
NSF	4,009	3,765	4,659	3,852	1,851	3,915	4,888	3,327	
Other Agencies	2,234	2,099	1,948	2,107	3,165	1,438	1,993	1,940	Estimates.
TOTAL CA	14,421,395	13,545,720	12,883,896	14,409,911	13,227,036	13,303,532	11,734,120	15,715,828	Estimates.
USDA	94,487	88,731	101,350	89,937	77,894	84,692	90,276	88,237	
DOC	75,707	71,110	80,711	72,647	96,918	86,514	36,871	53,000	
DOD	8,065,348	7,594,402	6,437,210	8,173,914	7,380,150	7,273,244	6,598,125	9,703,766	
DOE	1,315,476	1,235,599	1,323,305	1,286,714	1,090,602	1,211,815	1,183,312	1,317,847	
HHS	1,409,902	1,324,292	1,537,041	1,392,395	1,352,629	1,305,916	1,210,321	1,147,451	
DOI	48,703	43,867	36,965	44,704	46,415	45,125	49,720	40,275	
DOT	29,981	28,142	23,566	25,372	24,387	33,854	31,648	30,026	
EPA	18,186	17,091	31,969	2,291	13,947	25,367	15,035	13,937	
NASA	2,674,294	2,511,909	2,673,733	2,658,380	2,491,918	2,645,135	1,963,211	2,639,079	
NSF	392,067	368,260	396,373	391,914	383,979	406,702	310,882	319,711	
Other Agencies	279,274	262,316	241,673	271,643	268,197	185,168	244,719	362,499	Estimates.

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS "MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS "MAX" System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97-98-99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL CO	1,422,790	1,336,397	1,425,860	1,419,616	1,336,684	1,010,354	1,419,984	1,405,886	Estimates
USDA	32,909	30,911	27,321	33,396	29,603	31,749	31,312	32,084	
DOC	88,312	82,950	93,196	88,955	82,749	77,531	83,517	71,752	
DOD	624,167	586,268	559,410	574,734	601,483	372,540	687,688	721,750	
DOE	142,531	133,877	142,482	169,706	140,714	46,656	147,869	155,832	
HHS	174,453	163,860	187,331	177,984	158,794	151,008	163,720	144,325	
DOI	54,590	51,275	45,101	66,003	45,834	45,647	53,753	51,314	
DOT	12,580	11,816	12,903	10,835	15,507	11,239	9,525	10,885	
EPA	6,883	6,259	10,201	10,148	5,592	6,364	1,707	3,539	
NASA	119,067	111,837	156,662	112,274	108,776	115,988	92,923	84,400	
NSF	139,715	131,231	164,822	148,824	120,436	137,570	118,262	97,474	
Other Agencies	27,802	26,114	26,431	26,757	27,196	14,062	29,708	32,531	Estimates
TOTAL CT	819,583	769,798	708,555	868,032	819,864	920,220	752,894	549,228	Estimates
USDA	6,914	6,495	6,151	7,747	7,028	6,021	5,876	6,144	
DOC	10,098	9,457	5,728	15,925	20,459	7,806	3,134	3,688	
DOD	408,178	383,393	283,580	448,874	408,664	559,049	398,489	201,701	
DOE	82,340	58,563	54,850	64,961	58,540	64,194	56,841	51,991	
HHS	228,071	214,223	237,450	227,530	214,966	200,739	207,542	197,098	
DOI	1,963	1,844	1,467	2,184	1,351	1,275	1,436	3,352	
DOT	17,537	16,472	14,587	15,712	14,095	14,248	16,772	23,418	
EPA	2,133	2,004	891	1,405	619	1,372	1,716	6,018	
NASA	42,823	40,317	63,438	44,342	55,231	29,586	25,256	24,048	
NSF	23,823	22,377	26,747	22,983	22,018	23,222	20,208	19,082	
Other Agencies	15,603	14,656	13,656	16,369	16,893	12,708	15,624	12,686	Estimates
TOTAL DE	59,815	56,183	46,896	52,368	66,562	59,089	52,599	59,586	Estimates
USDA	4,823	4,530	3,819	3,781	5,653	5,558	4,240	4,131	
DOC	6,415	6,025	1,818	1,789	15,344	8,240	3,307	5,653	
DOD	17,454	16,394	11,735	15,074	12,800	21,217	16,446	21,094	
DOE	2,381	2,237	1,504	1,751	5,509	1,562	1,586	1,509	
HHS	8,769	6,358	7,577	7,439	6,773	4,869	6,871	4,617	
DOI	1,294	1,215	828	922	889	1,068	759	2,826	
DOT	4,510	4,237	922	4,580	4,057	4,222	5,103	6,535	
EPA	1,118	1,051	1,554	636	1,828	522	1,242	521	
NASA	3,048	2,863	4,611	3,088	2,012	2,358	2,954	2,152	
NSF	10,946	10,188	11,635	12,321	10,352	8,650	8,993	9,176	
Other Agencies	1,150	1,086	893	987	1,345	823	1,098	1,372	Estimates
TOTAL DC	2,888,421	2,525,178	2,286,249	2,282,374	2,634,705	2,847,401	2,538,609	2,561,732	Estimates Note: Error in NSF data for FY 93 R&D
USDA	165,968	155,326	169,925	159,481	143,062	143,197	167,065	149,228	
DOC	17,320	16,269	16,087	18,076	10,505	27,486	9,166	16,292	
DOD	1,258,456	1,182,024	1,094,165	1,022,235	1,372,069	1,396,638	957,343	1,249,691	
DOE	323,316	303,683	282,414	263,438	314,412	349,455	326,954	285,427	
HHS	121,213	199,327	179,498	195,779	179,105	221,836	216,072	203,674	
DOI	13,933	13,087	2,351	2,757	13,135	14,869	25,740	19,670	
DOT	140,829	132,277	145,327	131,979	132,231	177,455	135,016	71,656	
EPA	76,894	72,037	76,114	62,118	62,782	60,763	156,062	14,382	
NASA	344,457	323,542	197,747	306,652	251,108	341,124	420,810	423,808	
NSF	83,870	78,778	78,645	76,816	101,905	75,312	71,714	68,274	
Other Agencies	51,885	48,829	43,976	43,043	54,391	39,266	52,667	59,630	Estimates
TOTAL FL	3,173,957	2,981,233	2,873,121	3,457,688	3,088,277	2,479,766	3,072,444	2,916,100	Estimates
USDA	43,428	40,789	43,091	59,435	33,729	36,890	37,084	34,505	
DOC	39,783	37,376	46,249	36,926	35,005	29,084	40,022	36,972	
DOD	2,072,946	1,947,075	1,971,426	2,036,891	1,753,870	1,745,459	2,122,546	2,052,260	
DOE	44,396	41,700	57,929	65,920	17,815	21,046	71,844	15,848	
HHS	143,865	135,129	157,930	144,949	129,073	127,429	128,971	122,423	
DOI	16,573	17,445	28,666	24,874	12,831	14,195	11,898	12,208	
DOT	6,722	6,314	6,019	3,880	7,719	5,280	6,058	8,929	
EPA	15,278	14,351	14,104	10,644	15,225	19,052	12,659	14,420	
NASA	662,838	622,588	425,665	942,414	956,212	391,493	519,452	500,292	
NSF	64,283	60,361	67,647	66,564	63,959	55,476	57,453	51,064	
Other Agencies	81,860	58,104	54,395	65,191	62,839	34,362	64,457	67,379	Estimates

DERIVATION OF FEDERAL R&D FUNDING BY STATE 621

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS*MAX*System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS*MAX*System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97,98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL GA	4,429,102	4,160,165	3,514,273	4,000,511	4,228,424	4,439,383	5,667,044	3,111,354	Estimates.
USDA	54,727	51,404	47,835	48,875	47,246	56,149	54,638	53,882	
DOC	3,064	2,878	4,618	1,667	1,289	2,280	2,153	5,259	
DOD	3,880,865	3,645,217	2,979,619	3,472,381	3,704,874	3,900,476	5,122,137	2,891,817	
DOE	13,580	12,756	11,477	10,494	9,276	15,294	17,852	12,140	
HHS	296,714	278,697	313,446	296,194	293,309	306,242	261,755	201,236	
DOI	8,033	7,545	7,880	11,590	6,194	6,221	6,441	6,943	
DOT	8,728	8,198	4,935	11,771	4,381	7,302	14,913	5,885	
EPA	16,855	15,831	16,199	14,031	13,829	18,054	17,638	15,237	
NASA	26,797	25,170	22,841	22,543	26,128	31,224	25,217	23,064	
NSF	34,238	32,159	37,538	35,718	34,561	34,888	26,890	23,359	
Other Agencies	85,502	80,311	67,865	75,447	87,337	61,253	117,410	72,532	Estimates.
TOTAL HI	223,168	209,617	167,940	156,723	152,147	487,651	157,992	135,251	Estimates.
USDA	23,175	21,767	23,306	21,601	20,932	20,508	20,840	23,417	
DOC	14,019	13,168	16,193	14,839	11,006	11,085	13,138	12,744	
DOD	55,002	51,662	60,283	60,710	54,896	48,949	60,602	24,534	
DOE	5,707	5,360	3,541	3,005	3,114	6,342	3,217	12,941	
HHS	82,872	77,840	21,868	20,938	20,839	360,789	24,277	18,330	
DOI	10,574	9,932	5,810	5,988	12,205	10,797	10,920	13,869	
DOT	629	591	548	383	656	636	752	568	
EPA	96	90	0	140	140	248	0	15	
NASA	10,144	9,528	18,574	6,932	6,580	7,433	6,987	10,660	
NSF	16,986	15,954	14,638	19,232	18,659	14,141	13,871	15,184	
Other Agencies	3,967	3,726	3,179	2,955	3,120	6,725	3,388	2,989	Estimates.
TOTAL ID	273,571	256,959	229,324	236,356	268,894	223,047	245,418	338,717	Estimates.
USDA	20,990	19,716	18,836	23,038	18,223	19,754	19,024	19,419	
DOC	914	859	1,320	1,538	1,291	476	507	21	
DOD	18,473	15,472	19,502	18,128	14,059	12,898	12,641	15,606	
DOE	208,849	196,168	167,392	172,940	211,830	168,085	180,945	275,813	
HHS	2,031	1,908	2,869	1,538	1,787	1,806	1,780	1,667	
DOI	11,077	10,404	9,068	8,934	9,783	9,687	12,232	12,722	
DOT	2,530	2,376	2,228	2,416	974	1,330	5,774	1,536	
EPA	425	399	0	288	265	769	585	489	
NASA	853	802	912	570	2,153	724	393	58	
NSF	4,121	3,871	2,963	2,517	3,264	4,405	6,353	3,721	
Other Agencies	5,307	4,985	4,234	4,449	5,265	3,113	5,184	7,665	Estimates.
TOTAL IL	1,366,356	1,283,392	1,302,663	1,298,918	1,264,513	1,325,423	1,317,438	1,191,399	Estimates.
USDA	51,326	48,210	45,752	57,256	43,789	49,946	48,377	44,139	
DOC	10,420	9,796	4,720	14,973	12,764	19,638	4,203	2,475	
DOD	151,484	142,286	125,003	145,356	134,403	147,734	161,895	139,324	
DOE	656,851	616,967	586,237	580,479	590,767	668,330	665,237	610,752	
HHS	304,963	285,882	343,771	315,840	289,950	266,723	256,577	242,431	
DOI	3,943	3,704	5,786	3,735	2,442	2,291	2,933	5,036	
DOT	12,077	11,344	11,685	11,128	16,958	12,212	9,295	6,784	
EPA	2,335	2,193	2,860	2,409	1,020	3,941	1,796	1,133	
NASA	17,642	16,571	17,722	17,940	16,891	17,507	13,292	16,072	
NSF	130,182	122,277	136,604	125,346	131,645	118,018	124,857	97,193	
Other Agencies	25,726	24,164	22,523	24,456	23,884	19,083	28,976	26,060	Estimates.
TOTAL IN	475,012	446,169	368,273	426,586	459,963	437,020	416,353	548,820	Estimates.
USDA	17,401	16,344	14,246	17,077	15,963	16,956	15,932	17,870	
DOC	950	893	2,180	869	784	1,061	189	272	
DOD	251,035	235,792	176,279	201,363	250,648	229,513	222,148	334,800	
DOE	24,699	23,200	18,442	28,920	19,776	22,411	17,507	32,142	
HHS	100,879	94,848	106,863	100,809	93,707	91,482	88,461	87,763	
DOI	3,921	3,683	3,996	5,041	2,953	2,670	2,712	4,725	
DOT	3,197	3,003	3,612	1,075	1,027	8,218	2,219	1,864	
EPA	1,477	1,387	1,105	1,942	1,376	2,631	1,088	180	
NASA	13,974	13,126	7,708	12,526	19,869	11,452	10,582	16,618	
NSF	48,139	45,216	46,388	48,921	44,565	44,581	46,859	39,980	
Other Agencies	9,241	8,680	7,454	8,043	9,275	6,045	8,656	12,606	Estimates.

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS "MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS "MAX" System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97,98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL IA	251,840	235,549	247,930	241,586	228,762	233,092	238,980	228,941	Estimates.
USDA	47,580	44,691	42,332	44,420	40,725	51,592	46,391	42,684	
DOC	1,480	1,390	807	1,225	1,371	1,343	2,496	1,100	
DOD	30,534	28,680	28,202	37,325	22,135	21,344	33,186	29,890	
DOE	34,312	32,229	30,670	30,195	31,461	31,635	35,123	34,289	
HHS	95,392	89,600	105,919	92,903	87,509	82,815	85,090	83,361	
DOI	3,710	3,484	5,362	3,076	2,648	2,526	2,528	4,766	
DOT	8,554	8,034	3,051	4,925	10,184	15,988	7,231	6,827	
EPA	2,395	2,250	2,369	2,162	3,564	2,766	1,259	1,378	
NASA	8,098	7,550	10,666	6,717	8,018	7,197	5,903	6,797	
NSF	14,088	14,078	13,883	14,085	16,573	12,607	14,741	12,578	
Other Agencies	4,858	4,563	4,669	4,553	4,574	3,279	5,032	5,271	Estimates.
TOTAL KS	165,417	155,373	131,792	261,798	217,147	123,746	97,513	100,242	Estimates.
USDA	14,435	13,559	13,986	13,488	13,349	13,334	14,696	12,500	
DOC	334	314	1,028	564	78	173	38	0	
DOD	77,382	72,693	31,276	173,818	137,088	43,431	22,672	27,871	
DOE	5,378	5,052	4,190	4,813	4,868	6,239	4,926	5,276	
HHS	38,810	36,454	48,344	37,570	36,068	34,479	31,500	30,760	
DOI	4,740	4,452	6,466	4,961	3,545	3,362	3,353	5,027	
DOT	1,551	1,457	1,373	542	1,433	1,514	1,967	1,912	
EPA	2,914	2,737	2,842	2,849	1,410	4,970	4,351	1	
NASA	4,554	4,278	5,555	3,774	3,114	4,042	2,595	6,585	
NSF	12,112	11,377	14,193	14,482	11,728	10,491	9,309	8,059	
Other Agencies	3,196	3,002	2,539	4,937	4,466	1,711	2,106	2,251	Estimates.
TOTAL KY	112,507	105,675	192,681	93,484	83,144	81,528	94,477	88,738	Estimates.
USDA	10,015	9,407	7,845	8,474	8,290	9,595	11,263	10,975	
DOC	348	325	588	184	984	71	68	56	
DOD	10,948	10,283	9,613	9,530	8,178	10,855	7,561	15,960	
DOE	24,704	23,204	98,213	5,698	5,799	5,617	18,490	5,408	
HHS	47,050	44,194	53,102	51,828	43,950	38,605	39,287	38,389	
DOI	2,907	2,815	3,689	2,895	1,975	1,895	2,354	4,079	
DOT	1,568	1,473	3,418	866	829	1,419	1,240	1,063	
EPA	1,416	1,330	1,840	974	199	1,221	526	3,220	
NASA	2,342	2,200	1,533	1,552	3,143	1,409	4,830	732	
NSF	9,826	8,384	9,114	9,720	8,115	9,697	6,870	6,786	
Other Agencies	2,195	2,062	3,726	1,763	1,681	1,144	1,988	2,070	Estimates.
TOTAL LA	244,250	229,513	258,427	234,049	266,771	200,663	230,987	186,183	Estimates.
USDA	40,317	37,869	46,194	34,496	40,362	34,968	37,615	33,577	
DOC	4,045	3,799	3,124	8,011	3,693	2,910	2,365	2,691	
DOD	44,028	41,355	38,025	30,768	57,415	38,382	62,754	20,784	
DOE	11,749	10,782	4,319	9,989	10,291	11,582	6,652	21,860	
HHS	66,087	62,074	68,867	65,220	61,406	56,013	62,118	58,821	
DOI	17,507	16,444	16,097	15,148	17,620	15,235	17,792	16,772	
DOT	1,395	1,311	1,676	803	1,105	1,551	1,470	1,259	
EPA	4,065	3,818	4,962	6,651	1,219	5,868	2,409	1,799	
NASA	38,081	35,778	59,466	40,644	55,732	20,695	21,510	16,622	
NSF	12,743	11,970	11,231	17,910	12,820	10,601	11,348	7,908	
Other Agencies	4,693	4,314	4,466	4,409	5,108	2,858	4,954	4,090	Estimates.
TOTAL ME	78,992	74,195	107,526	70,344	59,008	55,986	84,507	67,801	Estimates.
USDA	6,504	5,170	3,943	4,529	4,161	5,857	6,233	6,297	
DOC	4,922	4,624	6,370	5,335	2,079	3,061	3,297	7,599	
DOD	23,234	21,823	48,148	19,539	12,488	5,780	31,283	13,704	
DOE	3,241	3,984	223	2,035	3,455	5,898	7,701	4,589	
HHS	25,554	24,003	32,072	26,601	22,134	23,473	22,315	17,420	
DOI	2,574	2,418	3,976	1,806	1,842	1,744	1,558	3,583	
DOT	1,463	435	565	151	316	528	656	396	
EPA	1,338	1,257	996	683	918	585	1,757	2,600	
NASA	1,578	1,482	2,701	1,091	1,252	2,118	937	792	
NSF	3,032	7,549	6,480	7,248	9,148	6,167	7,004	9,248	
Other Agencies	1,545	1,451	2,052	1,326	1,217	775	1,766	1,573	Estimates.

DERIVATION OF FEDERAL R&D FUNDING BY STATE 623

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS "MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS "MAX" System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97,98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted Average of TOTALS (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL MD	8,079,077	7,588,511	8,429,223	7,775,054	7,116,170	7,535,089	6,995,631	7,679,898	Estimates. Note: Error in NSF data for FY 93 R&D.
USDA	150,539	141,398	145,962	144,077	144,200	145,288	125,615	143,247	
DOC	370,110	347,637	367,902	356,806	426,074	446,333	283,976	204,728	
DOD	2,862,901	2,801,778	2,728,381	2,646,927	2,338,309	2,923,299	2,574,260	3,599,482	
DOE	70,925	66,618	58,127	50,653	50,919	60,821	92,372	86,816	
HHS	3,030,741	2,846,713	3,471,894	3,219,674	2,888,558	2,452,695	2,622,802	2,424,652	
DOI	18,814	17,484	12,353	17,555	15,828	16,863	18,359	23,946	
DOT	137,064	34,814	24,572	33,540	24,855	52,528	39,412	33,975	
EPA	10,187	9,569	8,056	11,600	14,468	6,562	8,617	8,109	
NASA	1,190,303	1,118,587	1,392,613	1,086,969	999,040	1,268,827	1,032,039	934,093	
NSF	81,589	57,831	61,737	60,710	70,495	58,331	51,704	44,007	
Other Agencies	155,517	146,074	157,616	146,543	143,424	105,542	146,475	176,843	Estimates.
TOTAL MA	3,610,848	3,391,596	3,184,343	3,516,359	3,261,282	3,408,738	3,318,713	3,659,140	Estimates.
USDA	24,666	23,158	22,959	21,966	23,167	27,745	22,099	21,144	
DOC	50,102	47,060	44,145	51,887	52,014	57,772	38,520	38,022	
DOD	1,908,784	1,793,821	1,440,665	1,819,917	1,684,831	1,817,270	1,821,321	2,178,923	
DOE	107,677	101,139	105,794	114,017	98,163	105,588	93,614	89,655	
HHS	1,037,381	974,400	1,124,935	1,049,216	977,738	939,272	901,840	853,398	
DOI	6,762	6,351	6,062	6,434	5,353	6,397	6,471	7,381	
DOT	55,529	52,157	38,016	43,819	44,087	63,704	43,174	80,144	
EPA	20,901	19,632	19,434	14,755	13,467	25,613	19,823	24,701	
NASA	150,346	141,217	143,316	153,971	144,167	146,411	126,941	132,493	
NSF	177,423	166,649	177,632	174,063	151,077	172,862	176,139	148,123	
Other Agencies	70,288	66,001	61,385	66,314	67,198	47,104	68,861	85,146	Estimates.
TOTAL MI	827,332	777,096	766,166	754,424	727,126	702,698	791,176	920,988	Estimates.
USDA	24,829	23,321	21,307	20,876	17,848	20,362	23,299	36,234	
DOC	28,567	26,832	24,263	29,343	25,100	47,728	19,905	14,654	
DOD	312,899	293,899	230,914	251,334	250,190	220,544	339,519	470,895	
DOE	15,620	14,671	16,080	12,839	13,060	14,183	14,728	17,138	
HHS	288,665	272,076	306,905	292,556	274,880	254,994	258,587	244,536	
DOI	8,487	7,953	10,130	7,519	6,306	6,792	7,262	9,711	
DOT	6,935	6,514	7,487	4,657	6,676	9,416	4,828	6,020	
EPA	15,929	14,962	18,849	15,754	17,002	21,217	12,541	4,408	
NASA	26,681	25,061	30,522	19,128	23,981	22,263	23,419	31,055	
NSF	81,532	76,581	84,946	86,191	77,149	75,492	70,668	65,044	
Other Agencies	16,208	15,224	14,763	14,227	14,934	9,707	16,422	21,293	Estimates.
TOTAL MN	852,905	613,261	826,523	623,801	699,110	584,282	486,638	459,209	Estimates.
USDA	25,852	24,095	23,592	22,590	23,144	25,684	24,632	24,927	
DOC	10,673	10,025	4,578	10,470	18,358	15,748	2,727	8,270	
DOD	312,355	293,389	492,799	302,187	366,991	255,346	184,886	158,125	
DOE	8,927	6,506	6,605	6,334	6,164	5,848	6,887	7,198	
HHS	210,577	197,790	211,333	203,687	203,810	198,156	187,722	182,034	
DOI	10,752	10,089	8,049	6,443	4,312	4,101	17,664	20,026	
DOT	6,524	5,189	5,339	1,197	3,722	6,338	5,309	9,227	
EPA	13,921	13,075	14,718	15,388	15,098	18,028	10,378	4,846	
NASA	7,395	6,890	10,324	6,534	7,559	8,511	4,152	4,260	
NSF	36,809	34,386	33,266	37,209	35,597	38,446	32,187	29,612	
Other Agencies	12,580	11,816	15,920	11,764	14,355	8,076	10,096	10,684	Estimates.
TOTAL MS	321,840	302,297	333,546	334,926	289,493	252,985	293,964	308,871	Estimates.
USDA	62,937	59,115	69,519	55,944	57,635	59,448	56,854	55,290	
DOC	16,456	15,456	6,275	9,415	8,246	7,552	56,948	4,302	
DOD	116,330	109,266	133,057	121,344	96,373	98,167	82,538	124,117	
DOE	8,532	6,136	1,995	1,060	2,238	3,662	3,673	24,185	
HHS	14,251	13,386	13,914	14,881	12,555	12,032	14,060	12,871	
DOI	4,650	4,368	6,320	3,384	2,538	2,520	2,959	8,485	
DOT	2,044	1,920	1,923	3,118	1,412	2,091	2,009	968	
EPA	1,012	951	1,542	893	1,077	1,195	638	460	
NASA	84,870	79,717	85,435	112,703	96,552	55,289	61,174	67,146	
NSF	6,683	6,278	7,946	5,880	5,385	7,385	6,865	4,205	
Other Agencies	6,075	5,706	5,619	6,304	5,482	3,844	6,346	6,842	Estimates.

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS*MAX System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS*MAX System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97-98-99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL MO	1,441,249	1,353,735	953,128	1,157,649	1,301,309	1,640,521	2,324,598	745,207	Estimates
USDA	23,251	21,839	20,693	25,846	23,876	20,439	21,516	18,663	
DOC	372	350	1,012	282	118	164	426	96	
DOD	1,101,921	1,035,012	581,523	812,953	977,621	1,342,029	2,010,504	485,440	
DOE	5,183	4,868	4,744	3,193	5,559	5,234	5,513	4,965	
HHS	229,944	215,982	264,584	237,585	221,131	203,994	192,178	176,417	
DOI	12,934	12,149	13,171	11,765	10,386	10,059	15,414	12,099	
DOT	2,898	2,722	2,779	3,258	2,106	2,063	2,571	3,555	
EPA	1,611	1,514	2,816	283	159	1,434	1,723	2,666	
NASA	13,887	13,025	18,642	16,052	11,547	14,504	9,109	8,296	
NSF	21,728	20,409	24,805	24,601	21,974	17,966	17,462	15,643	
Other Agencies	27,540	25,868	18,359	21,831	26,832	22,635	48,182	17,367	Estimates
TOTAL MT	79,856	74,820	84,273	90,644	69,618	70,737	61,368	72,277	Estimates
USDA	18,400	17,283	19,216	19,127	16,123	18,160	16,674	14,397	
DOC	1,710	1,606	5,091	1,664	397	2,084	400	0	
DOD	8,024	7,537	12,793	13,485	6,594	9,392	1,264	1,694	
DOE	6,515	6,120	984	1,565	2,136	4,847	4,339	22,848	
HHS	21,738	20,419	12,861	31,451	22,384	19,621	20,386	15,808	
DOI	8,140	7,646	14,887	6,707	5,449	5,541	5,546	7,747	
DOT	882	829	1,229	503	542	1,010	880	809	
EPA	284	267	321	330	0	205	134	610	
NASA	3,844	3,611	6,177	4,249	6,130	2,255	1,722	1,133	
NSF	8,588	8,066	9,120	9,857	8,512	6,626	8,723	5,559	
Other Agencies	1,529	1,437	1,594	1,706	1,351	996	1,300	1,672	Estimates
TOTAL NE	83,026	87,377	87,509	85,398	91,673	90,334	88,002	81,348	Estimates
USDA	28,833	26,894	28,277	27,335	25,329	27,537	27,122	25,764	
DOC	231	217	744	119	241	30	114	52	
DOD	13,214	12,411	7,617	7,996	17,561	10,232	19,504	11,558	
DOE	2,080	1,935	705	861	897	6,217	1,364	1,566	
HHS	28,604	27,806	30,566	28,627	28,385	27,554	25,483	26,221	
DOI	5,057	4,750	6,958	5,311	3,250	3,809	3,640	5,536	
DOT	747	702	905	587	559	746	733	681	
EPA	159	149	250	0	0	79	45	520	
NASA	1,895	1,780	2,305	2,355	1,112	1,919	1,656	1,332	
NSF	9,628	9,043	7,507	10,597	12,459	10,956	6,511	6,229	
Other Agencies	1,800	1,690	1,677	1,610	1,880	1,255	1,830	1,889	Estimates
TOTAL NV	380,066	356,988	299,481	301,732	274,313	416,941	382,660	466,801	Estimates
USDA	2,855	2,682	2,869	2,214	1,819	3,404	3,214	2,571	
DOC	361	339	115	161	6	728	580	443	
DOD	36,948	34,703	43,753	32,700	25,143	19,627	33,347	53,646	
DOE	278,497	261,587	197,359	209,845	187,561	336,719	289,851	348,184	
HHS	8,523	8,006	9,894	9,364	6,973	6,245	7,828	7,730	
DOI	14,328	13,458	9,508	10,716	12,173	11,738	17,984	18,631	
DOT	7,263	6,822	4,946	6,583	13,337	10,106	3,975	1,985	
EPA	14,474	13,595	14,637	15,141	12,660	12,583	10,219	16,330	
NASA	1,754	1,647	2,914	1,517	1,763	1,949	652	1,089	
NSF	7,725	7,256	7,746	7,801	7,454	7,930	6,867	5,735	
Other Agencies	7,340	6,894	5,740	5,690	5,424	5,912	8,143	10,457	Estimates
TOTAL NH	270,203	253,796	277,413	286,405	274,471	216,653	223,788	244,049	Estimates
USDA	5,075	4,767	4,818	4,549	4,687	4,587	5,260	4,700	
DOC	6,527	6,130	10,514	5,219	1,563	15,877	742	2,867	
DOD	181,791	170,752	184,396	203,657	192,154	130,311	148,698	165,297	
DOE	1,285	1,207	670	921	1,150	1,335	1,502	1,664	
HHS	36,115	36,740	35,610	39,531	38,444	35,525	35,335	35,994	
DOI	1,928	1,811	1,971	1,615	1,217	1,300	1,318	3,443	
DOT	1,681	1,579	2,191	574	1,258	2,594	1,856	998	
EPA	572	537	889	1,151	100	500	333	250	
NASA	15,140	14,221	18,349	11,959	15,581	12,422	14,146	12,869	
NSF	11,823	11,105	12,893	11,828	12,653	9,215	9,961	10,282	
Other Agencies	5,267	4,948	5,312	5,401	5,684	2,987	4,637	5,685	Estimates

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Table C.1—continued

			OMB 1996	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS "MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS "MAX" System
			NSF 1996	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97,98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1996 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL NJ	1,523,088	1,430,603	1,520,503	1,374,620	1,329,272	1,380,415	1,468,015	1,510,794	Estimates.
USDA	8,689	8,162	7,226	6,652	7,093	10,906	9,124	7,968	
DOC	33,881	31,805	23,458	39,083	44,085	44,822	23,470	15,909	
DOD	912,008	856,630	995,538	864,900	831,739	678,843	844,521	924,240	
DOE	122,713	115,262	82,797	84,366	83,312	160,497	129,566	151,035	
HHS	114,064	107,138	123,413	111,579	101,424	106,047	103,373	96,992	
DOI	6,400	6,012	5,458	9,407	4,504	5,093	5,589	6,020	
DOT	107,486	100,960	122,046	83,602	83,334	103,107	118,446	95,222	
EPA	4,369	4,104	5,044	3,794	3,564	8,228	2,381	1,614	
NASA	129,200	121,355	64,684	94,771	89,452	191,735	152,555	134,931	
NSF	54,742	51,418	62,000	50,551	53,696	51,956	48,219	42,084	
Other Agencies	29,554	27,759	28,839	25,915	27,069	19,181	30,771	34,779	Estimates.
TOTAL NM	2,307,591	2,167,473	2,043,023	2,097,478	2,073,138	2,151,067	2,091,268	2,548,864	Estimates.
USDA	8,695	8,168	7,683	12,184	8,140	7,387	7,451	6,160	
DOC	467	439	1,400	548	275	341	30	40	
DOD	778,458	731,189	598,781	686,827	757,927	787,261	609,959	946,380	
DOE	1,337,458	1,256,247	1,268,190	1,213,446	1,126,895	1,183,267	1,318,159	1,427,527	
HHS	42,026	39,474	46,423	50,160	35,148	35,773	36,718	32,621	
DOI	6,857	6,441	9,351	6,329	5,086	5,219	5,616	7,045	
DOT	10,753	10,100	6,371	12,345	8,403	19,876	5,664	7,943	
EPA	1,674	1,573	4,278	671	905	2,304	857	420	
NASA	62,267	58,486	48,886	61,416	74,283	63,658	51,206	51,466	
NSF	14,333	13,462	14,147	14,033	14,408	15,756	11,059	11,371	
Other Agencies	44,602	41,894	37,513	39,519	41,668	30,225	44,549	57,891	Estimates.
TOTAL NY	2,937,817	2,759,431	2,724,528	2,673,767	2,710,101	2,779,473	2,944,268	2,724,448	Estimates.
USDA	41,093	38,598	38,571	38,222	36,359	40,383	41,625	36,428	
DOC	14,722	13,828	18,360	12,554	18,563	21,434	7,220	4,838	
DOD	781,035	733,610	606,359	621,407	735,475	774,078	889,190	775,151	
DOE	728,603	684,362	657,188	647,138	650,194	699,430	730,775	721,448	
HHS	1,027,891	965,477	1,080,524	1,016,947	948,845	914,029	935,891	896,626	
DOI	7,390	6,932	8,200	9,181	5,441	5,335	6,396	7,036	
DOT	14,733	13,839	9,836	7,939	11,637	15,059	12,594	25,968	
EPA	6,966	6,543	8,621	8,990	3,373	7,333	5,879	5,062	
NASA	50,517	47,449	59,049	50,308	37,978	43,481	44,276	49,604	
NSF	217,819	204,687	187,273	210,701	208,735	219,915	207,959	193,540	
Other Agencies	46,957	44,106	50,547	50,380	53,501	38,996	62,463	8,749	Estimates.
TOTAL NC	922,898	866,859	973,371	946,204	853,920	863,228	791,015	773,418	Estimates.
USDA	36,484	34,268	33,743	31,186	31,124	35,329	37,834	36,394	
DOC	16,913	15,887	13,234	20,300	12,123	18,415	13,907	17,340	
DOD	143,600	134,881	140,370	150,960	134,930	136,815	133,173	113,037	
DOE	14,868	13,965	17,038	13,467	12,403	13,817	13,378	13,687	
HHS	482,972	453,646	518,413	481,292	468,022	452,592	378,860	422,697	
DOI	5,476	5,143	7,504	6,761	4,131	3,645	3,662	5,156	
DOT	6,494	6,100	5,095	8,257	6,519	6,418	5,068	5,240	
EPA	133,228	125,138	160,034	150,216	109,028	118,207	119,578	93,765	
NASA	13,948	13,099	13,266	15,173	10,408	11,825	18,565	9,356	
NSF	51,191	48,083	46,385	50,756	47,894	54,155	50,283	39,022	
Other Agencies	17,727	16,551	18,289	17,836	17,338	12,010	16,707	17,724	Estimates.
TOTAL ND	58,247	54,710	56,329	57,837	47,464	52,922	56,595	57,112	Estimates.
USDA	31,073	29,187	28,827	28,612	25,780	29,756	29,584	32,560	
DOC	353	331	659	358	0	289	387	295	
DOD	2,166	2,035	2,556	2,234	2,160	1,364	1,725	2,170	
DOE	5,386	5,059	5,167	3,746	4,393	5,453	6,145	5,449	
HHS	3,686	3,472	2,872	3,540	3,947	2,947	4,485	3,041	
DOI	6,809	6,395	6,893	6,485	5,464	5,445	5,973	8,111	
DOT	1,789	1,681	1,720	5,843	354	1,145	531	492	
EPA	1,653	1,553	1,100	2,310	492	1,318	2,497	1,600	
NASA	815	766	1,854	1,000	684	584	318	154	
NSF	3,381	3,176	3,648	2,619	3,231	3,871	3,730	1,955	
Other Agencies	1,125	1,056	1,033	1,090	959	750	1,220	1,285	Estimates.

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS "MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS "MAX" System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97-98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL OH	2,738,882	2,572,575	5,763,281	1,966,600	1,787,113	1,986,984	1,898,845	2,032,629	Estimates.
USDA	17,937	16,848	15,830	17,947	15,399	16,298	17,406	18,207	
DOC	9,056	8,506	4,387	10,267	19,243	13,284	2,914	940	
DOD	1,645,832	1,545,709	4,572,451	958,275	851,784	892,448	893,822	1,105,471	
DOE	28,795	27,046	16,901	17,800	20,345	48,151	26,042	33,039	
HHS	314,885	295,765	360,554	327,384	303,414	288,112	259,862	235,263	
DOI	4,557	4,281	5,397	6,635	3,622	3,643	3,801	5,586	
DOT	15,200	14,277	14,638	12,712	12,458	21,413	11,681	12,758	
EPA	63,079	59,249	92,658	61,580	56,170	60,993	49,838	34,256	
NASA	545,950	512,800	531,401	479,396	428,824	576,612	556,462	504,102	
NSF	40,907	38,423	39,220	40,530	39,946	38,009	36,684	36,151	
Other Agencies	52,884	49,673	109,844	37,074	35,908	28,021	40,333	46,856	Estimates.
TOTAL OK	164,680	154,680	181,562	170,223	143,639	164,474	146,431	121,751	Estimates.
USDA	20,000	18,785	18,777	22,533	18,399	18,201	17,892	16,913	
DOC	7,128	6,695	6,642	8,075	6,503	8,486	6,423	4,043	
DOD	34,760	32,649	41,440	38,219	26,485	33,970	30,727	25,055	
DOE	29,084	27,299	26,873	28,919	24,974	38,462	25,680	18,885	
HHS	30,813	28,942	35,683	32,408	30,359	27,330	25,327	22,544	
DOI	4,030	3,785	5,489	3,763	2,885	2,868	2,827	4,879	
DOT	12,479	11,721	11,787	9,808	11,237	8,856	18,115	10,523	
EPA	9,184	8,626	14,326	9,088	7,689	8,880	4,403	7,372	
NASA	1,656	1,556	3,301	2,049	1,140	1,132	875	838	
NSF	12,416	11,662	13,779	12,153	11,048	14,010	11,114	7,869	
Other Agencies	3,150	2,958	3,465	3,208	2,920	2,279	3,048	2,830	Estimates.
TOTAL OR	320,146	300,706	324,086	331,785	321,449	286,384	291,710	248,823	Estimates.
USDA	41,485	38,966	35,688	42,907	39,309	40,806	38,262	36,826	
DOC	17,364	16,310	16,004	20,875	23,028	13,681	15,004	9,266	
DOD	32,817	30,825	16,678	22,991	39,487	38,898	38,068	28,826	
DOE	29,283	27,505	34,653	46,093	33,519	15,815	15,031	19,916	
HHS	113,884	106,969	137,526	121,710	101,169	101,921	95,716	83,770	
DOI	16,532	15,528	12,117	9,802	13,619	13,529	22,072	22,031	
DOT	3,215	3,020	1,834	1,622	6,323	2,128	4,378	1,835	
EPA	19,883	18,676	24,064	21,840	23,330	20,509	11,801	10,512	
NASA	9,045	8,496	9,159	6,565	6,707	7,874	14,522	6,149	
NSF	30,473	28,623	30,152	31,125	28,438	27,253	30,762	24,007	
Other Agencies	8,163	5,789	8,211	6,255	6,520	3,970	6,094	5,685	Estimates.
TOTAL PA	2,347,560	2,205,015	1,941,425	1,971,794	2,018,564	2,484,060	2,089,286	2,724,961	Estimates.
USDA	47,799	44,897	44,158	42,488	45,981	52,175	42,481	42,096	
DOC	12,414	11,660	5,924	27,121	15,904	13,774	4,583	2,656	
DOD	970,559	911,626	587,599	614,966	756,082	1,145,501	872,248	1,493,361	
DOE	415,000	389,801	350,489	378,594	361,973	462,286	373,798	411,664	
HHS	642,805	603,774	728,821	685,319	601,809	569,362	527,984	509,347	
DOI	18,410	17,292	8,140	8,710	5,264	6,057	35,801	39,782	
DOT	11,732	11,020	9,039	6,213	11,834	14,483	13,025	11,523	
EPA	4,480	4,208	4,751	6,343	3,484	4,910	2,671	3,090	
NASA	52,480	49,293	53,263	50,640	55,174	55,125	45,236	36,322	
NSF	128,409	118,733	112,016	114,225	120,117	125,991	127,662	112,389	
Other Agencies	45,472	42,711	37,225	37,175	40,942	34,396	43,797	62,731	Estimates.
TOTAL PR	58,815	55,244	65,373	60,453	50,778	47,587	52,029	na	Estimates.
USDA	11,054	10,383	13,574	9,525	9,411	9,476	9,929	na	
DOC	550	516	994	363	379	400	446	na	
DOD	1,522	1,430	1,953	2,023	1,621	159	1,393	na	
DOE	585	550	841	784	999	32	93	na	
HHS	25,555	24,004	28,619	25,181	22,671	21,915	21,632	na	
DOI	2,671	2,509	1,165	5,178	2,099	2,065	2,039	na	
DOT	321	302	0	197	293	468	551	na	
EPA	188	174	157	85	70	165	395	na	
NASA	1,170	1,099	3,755	1,742	0	0	0	na	
NSF	14,103	13,246	13,090	14,235	12,187	12,250	14,470	na	
Other Agencies	1,087	1,030	1,225	1,140	1,046	657	1,081	na	Estimates.

DERIVATION OF FEDERAL R&D FUNDING BY STATE 627

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS"MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS"MAX" System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97,98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted-Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL RI	515,388	484,093	406,995	416,338	599,803	530,106	443,249	508,069	Estimates.
USDA	3,720	3,494	1,835	1,948	5,367	7,592	2,159	2,061	
DOC	5,778	5,427	8,031	8,454	3,493	3,059	2,710	6,814	
DOD	410,206	385,298	300,753	307,758	501,158	432,487	357,060	412,572	
DOE	2,834	2,662	2,356	2,855	3,078	2,308	2,697	2,677	
HHS	45,294	42,544	49,613	49,652	42,248	37,781	38,774	37,194	
DOI	2,263	2,125	2,477	1,732	1,806	1,677	1,700	3,359	
DOT	1,144	1,074	1,001	796	819	1,426	1,046	1,357	
EPA	10,292	9,667	12,007	10,753	10,231	10,362	7,247	7,403	
NASA	3,787	3,538	3,308	3,573	2,950	4,338	3,589	3,472	
NSF	20,122	18,901	17,988	20,966	16,314	21,737	17,082	19,316	
Other Agencies	9,969	9,364	7,626	7,851	12,339	7,339	9,185	11,844	Estimates.
TOTAL SC	204,781	192,346	197,132	180,270	193,254	183,216	217,914	182,291	Estimates.
USDA	16,850	15,827	15,723	17,178	14,293	15,600	16,528	15,637	
DOC	20,711	19,453	16,886	19,342	18,280	40,099	8,848	13,263	
DOD	49,798	46,774	52,269	48,242	63,186	34,996	46,015	35,936	
DOE	51,484	48,358	28,331	29,922	41,094	38,425	83,693	68,862	
HHS	39,543	37,142	50,813	39,756	37,046	33,776	33,820	27,642	
DOI	3,756	3,528	4,501	3,432	3,112	2,784	2,827	4,509	
DOT	1,261	1,185	1,812	924	686	1,431	1,230	1,025	
EPA	946	888	2,312	1,239	365	465	521	428	
NASA	4,267	4,008	3,296	2,829	2,936	3,191	8,658	3,140	
NSF	12,187	11,447	17,504	14,009	8,296	9,912	11,141	7,820	
Other Agencies	3,979	3,737	3,685	3,397	3,960	2,537	4,633	4,209	Estimates.
TOTAL SD	39,320	36,932	47,497	43,134	38,316	31,267	32,845	28,534	Estimates.
USDA	7,135	6,702	7,084	7,044	8,131	5,593	6,139	6,218	
DOC	305	287	677	334	676	10	0	24	
DOD	1,521	1,429	1,799	3,015	1,303	403	601	1,453	
DOE	45	43	50	79	0	80	25	21	
HHS	3,319	3,117	2,578	2,855	2,974	2,745	4,658	2,894	
DOI	12,034	11,304	13,526	12,347	12,917	10,052	11,138	7,841	
DOT	605	568	781	367	444	688	619	529	
EPA	412	106	275	0	0	0	99	259	
NASA	9,093	8,541	15,950	8,905	7,902	7,760	5,485	5,244	
NSF	4,387	4,120	3,869	7,375	3,222	3,507	3,355	3,394	
Other Agencies	763	717	908	813	747	449	726	657	Estimates.
TOTAL TN	708,013	665,022	662,266	616,588	593,346	627,836	769,635	720,460	Estimates.
USDA	11,897	10,987	8,712	13,136	10,348	11,629	12,058	10,038	
DOC	1,617	1,519	1,598	1,198	1,025	1,115	1,161	3,015	
DOD	111,082	104,337	64,824	106,208	94,190	82,734	157,261	120,806	
DOE	352,389	330,992	347,484	268,546	283,588	330,623	387,227	368,483	
HHS	158,857	149,024	168,671	160,546	149,196	142,131	139,541	134,057	
DOI	4,610	4,330	6,193	4,403	3,509	3,074	3,438	5,361	
DOT	5,583	5,244	4,382	2,617	4,305	3,300	10,023	6,839	
EPA	1,349	1,267	1,467	1,203	1,599	1,101	1,056	1,176	
NASA	31,310	29,409	30,087	29,080	20,771	25,250	29,148	42,119	
NSF	45,920	14,953	16,546	18,034	12,901	18,066	12,155	12,016	
Other Agencies	13,798	12,961	12,302	11,617	11,914	8,813	16,567	16,550	Estimates.
TOTAL TX	4,022,107	3,777,882	4,227,578	3,774,086	3,624,091	4,204,841	3,793,985	3,042,614	Estimates.
USDA	73,222	68,776	66,330	87,154	62,187	65,074	67,503	64,409	
DOC	13,455	12,638	12,545	13,007	20,071	17,214	6,345	6,646	
DOD	1,359,345	1,276,805	1,100,554	1,217,906	1,435,381	1,391,562	1,452,836	1,062,591	
DOE	128,952	121,122	23,055	25,125	33,714	69,351	39,163	536,322	
HHS	493,437	463,476	525,969	498,011	472,043	443,460	439,580	401,790	
DOI	12,934	12,148	23,056	14,302	10,486	9,248	7,569	8,229	
DOT	13,734	12,900	12,444	9,831	16,266	17,447	10,347	11,066	
EPA	14,101	13,245	14,976	11,742	8,320	16,939	14,021	13,471	
NASA	1,754,872	1,648,315	2,293,986	1,744,247	1,411,846	2,029,937	1,601,418	808,456	
NSF	81,583	76,629	73,843	81,601	79,728	86,282	76,169	62,350	
Other Agencies	76,472	71,829	81,120	71,180	74,049	58,327	79,034	67,284	Estimates.

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS*MAX*System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS*MAX*System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,535	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97-98-99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL UT	376,806	353,926	402,035	328,845	361,918	381,745	339,470	309,546	Estimates.
USDA	14,883	13,791	13,707	13,564	12,390	13,902	15,626	13,557	
DOC	2,253	2,116	2,293	1,747	1,973	4,409	1,716	559	
DOD	219,131	205,826	240,273	185,937	230,769	228,015	178,524	171,436	
DOE	10,091	9,478	8,000	6,027	5,553	16,848	9,662	10,779	
HHS	74,754	70,215	78,397	77,998	67,690	73,493	62,116	61,594	
DOI	9,080	8,529	7,802	4,086	6,126	5,621	12,779	14,758	
DOT	3,529	3,315	852	1,531	559	1,417	14,452	1,077	
EPA	977	918	1,208	748	127	1,259	0	2,165	
NASA	11,513	10,814	16,306	10,177	6,892	6,940	15,818	8,751	
NSF	23,530	22,101	25,449	20,829	22,399	24,556	21,692	17,681	
Other Agencies	7,286	6,825	7,748	6,201	7,440	5,285	7,085	7,189	Estimates.
TOTAL VT	58,119	54,590	58,838	51,312	49,825	54,348	49,537	63,678	Estimates.
USDA	6,358	5,972	5,418	5,584	7,391	5,785	5,676	5,977	
DOC	215	202	776	223	148	45	18	0	
DOD	12,078	11,345	13,640	10,338	7,352	13,582	6,260	16,897	
DOE	524	492	584	250	500	534	544	539	
HHS	29,900	28,084	29,291	25,344	26,588	26,937	29,267	31,077	
DOI	2,191	2,058	1,378	1,920	1,874	1,804	1,789	3,585	
DOT	539	506	497	1,154	247	419	370	350	
EPA	307	289	743	371	54	51	204	309	
NASA	658	618	699	790	996	663	347	215	
NSF	4,219	3,963	4,676	4,370	3,679	3,779	4,031	3,244	
Other Agencies	1,129	1,061	1,136	968	996	749	1,031	1,485	Estimates.
TOTAL VA	4,593,280	4,314,374	4,824,995	5,000,690	4,768,731	3,736,073	3,938,936	3,616,820	Estimates.
USDA	11,875	11,154	9,580	10,526	9,637	12,129	12,844	12,208	
DOC	29,429	27,643	13,022	17,973	18,738	36,758	55,393	23,971	
DOD	3,343,952	3,140,905	3,691,392	3,883,980	3,668,143	2,549,980	2,653,297	2,398,640	
DOE	105,407	99,007	94,280	99,161	96,457	104,830	104,093	95,221	
HHS	165,383	155,341	167,903	149,469	148,011	146,354	149,896	170,410	
DOI	60,231	56,573	43,493	98,366	42,216	52,313	57,411	45,641	
DOT	47,159	44,295	32,455	41,295	44,299	58,684	53,793	35,246	
EPA	34,364	32,278	21,704	18,866	23,729	33,901	37,979	57,487	
NASA	643,567	604,489	585,686	523,687	559,858	625,888	686,799	645,015	
NSF	82,868	59,049	73,123	63,072	60,133	63,385	44,827	49,753	
Other Agencies	89,048	83,641	92,357	94,295	97,510	51,851	82,604	83,228	Estimates.
TOTAL WA	1,254,528	1,178,353	1,283,225	1,315,727	1,246,541	1,209,010	1,043,868	971,745	Estimates.
USDA	43,898	41,045	37,095	43,720	37,141	42,245	51,272	34,797	
DOC	64,222	60,322	64,050	62,524	72,277	58,453	59,818	44,811	
DOD	387,493	363,964	421,089	427,471	428,683	346,342	274,002	286,198	
DOE	232,941	218,796	171,655	230,206	202,140	288,414	221,797	198,566	
HHS	345,508	324,528	381,710	366,810	329,740	308,384	290,859	269,666	
DOI	18,716	17,580	11,445	12,010	14,117	14,880	22,731	30,297	
DOT	5,790	5,439	5,148	4,258	6,431	4,378	3,110	9,307	
EPA	2,809	2,638	5,272	3,839	2,737	2,145	858	978	
NASA	76,021	71,405	109,969	89,112	74,502	77,831	48,929	28,085	
NSF	53,339	50,100	51,233	50,982	54,105	48,997	48,293	46,991	
Other Agencies	23,992	22,535	24,559	24,795	24,668	16,941	22,199	22,049	Estimates.
TOTAL WV	280,798	244,960	260,251	199,669	261,853	306,013	222,294	219,682	Estimates.
USDA	22,379	21,020	21,621	21,091	19,901	21,639	20,809	21,060	
DOC	556	523	647	1,496	840	153	0	0	
DOD	15,185	14,263	18,068	15,575	16,139	17,023	14,528	4,245	
DOE	115,172	108,178	102,577	71,043	129,525	138,577	97,413	109,935	
HHS	37,838	35,540	39,299	31,646	41,191	59,614	21,639	19,851	
DOI	8,452	7,939	7,089	6,747	5,865	6,377	8,952	12,604	
DOT	2,032	1,908	2,453	1,491	1,454	2,611	2,345	1,096	
EPA	132	124	187	0	0	10	308	241	
NASA	16,854	15,831	19,425	11,334	8,722	22,831	19,034	13,640	
NSF	37,247	34,986	44,073	35,481	32,843	32,936	32,623	31,958	
Other Agencies	4,948	4,648	4,812	3,765	5,373	4,242	4,643	5,052	Estimates.

Table C.1—continued

			OMB 1998	OMB 1997	OMB 1996	OMB 1995	OMB 1994	OMB 1993	
BA			76,365,000	74,003,000	71,339,000	71,038,000	71,157,872	na	SOURCE: OMBBPS"MAX" System
OUT			75,405,000	73,530,000	70,781,000	70,414,000	68,906,375	71,598,662	SOURCE: OMBBPS"MAX" System
			NSF 1998	NSF 1997	NSF 1996	NSF 1995	NSF 1994	NSF 1993	
OBS (All Agencies)			73,743,457	71,744,603	69,401,163	70,442,935	69,450,776	70,414,697	Table C-1 (Fed Funds FY 97,98,99)
OBS (10 Agencies)			72,349,652	70,392,094	67,993,135	69,462,377	67,994,955	68,798,660	Note: Total for R&D and R&D+Plant do not correspond to raw numbers in original data from NSF for 1993.
	Adjusted Average (Estimates)	Simple Average of TOTALS (Estimates)	NSF 1998 TOTAL	NSF 1997 TOTAL	NSF 1996 TOTAL	NSF 1995 TOTAL	NSF 1994 TOTAL	NSF 1993 TOTAL	
TOTAL WI	375,823	353,003	339,866	340,614	341,609	361,689	366,947	367,290	Estimates
USDA	39,391	36,999	35,288	36,075	33,381	37,977	40,859	38,416	
DOC	4,067	3,811	4,547	4,040	4,795	5,144	2,177	2,160	
DOD	33,415	31,366	11,998	21,921	25,937	30,954	39,923	57,582	
DOE	20,950	19,678	20,031	17,379	15,924	19,491	22,365	22,877	
HHS	174,705	164,097	185,558	171,359	162,331	163,851	152,319	149,161	
DOI	14,783	13,886	12,733	17,156	11,880	12,607	15,770	13,168	
DOT	3,957	3,717	2,952	3,787	3,443	5,587	3,506	3,028	
EPA	1,935	1,817	1,988	2,349	869	2,010	1,748	1,939	
NASA	29,826	28,015	14,615	19,377	27,042	36,187	37,304	33,563	
NSF	45,495	42,733	43,604	40,748	48,992	42,854	43,298	36,899	
Other Agencies	7,309	6,865	6,552	6,423	7,015	5,027	7,678	8,497	Estimates
TOTAL WY	40,786	38,310	34,878	29,520	39,042	37,158	39,252	50,008	Estimates
USDA	8,051	7,562	7,070	7,485	6,791	8,035	8,442	7,549	
DOC	188	177	24	396	583	57	0	0	
DOD	2,739	2,572	2,951	1,889	3,405	2,163	2,336	2,690	
DOE	7,190	6,753	3,787	4,649	3,412	5,268	9,866	13,536	
HHS	1,450	1,362	1,936	1,162	1,136	1,097	1,192	1,648	
DOI	5,446	5,116	7,454	3,913	4,458	4,089	4,384	6,395	
DOT	6,923	6,502	1,778	359	11,031	9,222	5,832	10,791	
EPA	383	360	450	602	129	477	40	460	
NASA	738	693	850	616	549	806	960	376	
NSF	6,876	6,459	7,913	7,893	6,748	5,425	5,372	5,402	
Other Agencies	803	754	663	556	800	519	828	1,161	Estimates
TOTAL FOR OTHER GEO. LOCATIONS	141,654	133,052	74,356	94,972	181,691	171,746	142,497	372,852	Estimates. Includes PR for FY 1993
USDA	7,807	7,333	6,522	7,018	7,646	7,577	7,902	17,294	Includes PR for FY 1993
DOC	892	837	35	863	1,103	1,236	950	16,351	Includes PR for FY 1993
DOD	54,118	50,832	60,506	63,424	57,774	51,813	20,643	188,374	Includes PR for FY 1993
DOE	479	450	0	0	0	2,200	48	145	Includes PR for FY 1993
HHS	725	681	0	669	553	1,116	1,069	19,408	Includes PR for FY 1993
DOI	71,675	67,604	5,409	20,675	107,797	100,756	103,384	3,032	Includes PR for FY 1993
DOT	217	204	530	331	25	0	134	376	Includes PR for FY 1993
EPA	498	467	0	0	354	0	1,983	102,334	Includes PR for FY 1993
NASA	2,154	2,024	0	0	2,688	4,134	3,296	2,026	Includes PR for FY 1993
NSF	212	199	0	203	127	536	131	14,934	Includes PR for FY 1993
Other Agencies	2,577	2,420	1,354	1,789	3,624	2,378	2,957	8,578	Estimates

Appendix D

Federal In-House R&D Activities by Agency

The following table is an agency-by-agency listing of where federal R&D funds are being spent in house.

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.)		
DOC	NIST	Building and Fire Research Laboratory	Maryland	Gaithersburg
DOC	NIST	Chemical Science and Technology Laboratory	Maryland	Gaithersburg
DOC	NIST	Electronics and Electrical Engineering Laboratory	Maryland	Gaithersburg
DOC	NIST	Information Technology Laboratory	Maryland	Gaithersburg
DOC	NIST	Manufacturing Engineering Laboratory	Maryland	Gaithersburg
DOC	NIST	Materials Science and Engineering Laboratory	Maryland	Gaithersburg
DOC	NIST	Physics Laboratory	Maryland	Gaithersburg
DOC	NOAA	Advanced Development and Demonstration Laboratory (NWS)	Maryland	Silver Spring
DOC	NOAA	Aeronomy Laboratory (OAR)	Colorado	Boulder
DOC	NOAA	Air Resources Laboratory (OAR)	Maryland	Silver Spring
DOC	NOAA	Alaska Fisheries Science Center Headquarters (see Seattle Laboratory) (NMFS)	Washington	Seattle
DOC	NOAA	Atlantic Oceanographic and Meteorological Laboratory (OAR)	Florida	Miami
DOC	NOAA	Auke Bay Laboratory (NMFS)	Alaska	Juneau
DOC	NOAA	Beaufort/Oxford Laboratory (NMFS)	North Carolina	Beaufort
DOC	NOAA	Center for Coastal Fisheries and Habitat Research (NMFS)	Maryland	Oxford
DOC	NOAA	Channel Islands National Marine Sanctuary (NOS)	California	Santa Barbara
DOC	NOAA	Charleston Laboratory and research ship <i>Ferrel</i> (NOS)	South Carolina	Charleston
DOC	NOAA	Climate Diagnostics Center (OAR)	Colorado	Boulder
DOC	NOAA	Climate Monitoring and Diagnostics Laboratory (OAR)	Colorado	Boulder
DOC	NOAA	Cordell Bank National Marine Sanctuary (NOS)	California	San Francisco
DOC	NOAA	Environmental Technology Laboratory (OAR)	Colorado	Boulder
DOC	NOAA	Florida Keys National Marine Sanctuary (NOS)	Florida	Marathon
DOC	NOAA	Forecast Systems Laboratory (OAR)	Colorado	Boulder
DOC	NOAA	Galveston Laboratory (NMFS)	Texas	Galveston
DOC	NOAA	Geophysical Fluid Dynamics Laboratory (OAR)	New Jersey	Princeton
DOC	NOAA	Geosciences Research Division (NOS)	Maryland	Silver Spring
DOC	NOAA	Gray's Reef National Marine Sanctuary (NOS)	Georgia	Savannah
DOC	NOAA	Great Lakes Environmental Research Laboratory (OAR)	Michigan	Ann Arbor
DOC	NOAA	Gulf of Farallones National Marine Sanctuary (NOS)	California	San Francisco
DOC	NOAA	Hammond Laboratory (NMFS)	Oregon	Hammond
DOC	NOAA	Honolulu Laboratory (NMFS)	Hawaii	Honolulu
DOC	NOAA	Hydrologic Research Laboratory (NWS)	Maryland	Silver Spring
DOC	NOAA	Integrated Systems Laboratory (NWS)	Maryland	Silver Spring
DOC	NOAA	Kodiak Laboratory (NMFS)	Alaska	Kodiak
DOC	NOAA	La Jolla Laboratory (NMFS)	California	La Jolla
DOC	NOAA	Manchester Facility (NMFS)	Washington	Manchester
DOC	NOAA	Miami Laboratory (NMFS)	Florida	Miami
DOC	NOAA	Millford Laboratory (NMFS)	Connecticut	Millford
DOC	NOAA	Mississippi Laboratory (NMFS)	Mississippi	Bay St. Louis
DOC	NOAA	Monitor National Marine Sanctuary (NOS)	Virginia	Newport News
DOC	NOAA	Monterey Bay National Marine Sanctuary (NOS)	California	Monterey
DOC	NOAA	Narragansett Laboratory (NMFS)	Rhode Island	Narragansett
DOC	NOAA	National Environmental Satellite, Data, and Information Serv (NESDIS) Office of Research and Applications	Maryland	Camp Springs
DOC	NOAA	National Severe Storms Laboratory (OAR)	Oklahoma	Norman
DOC	NOAA	National Systematics Laboratory (NMFS)	District of Columbia	
DOC	NOAA	Newport Facility (NMFS)	Oregon	Newport
DOC	NOAA	Olympic Coast National Marine Sanctuary (NOS)	Washington	Port Angeles
DOC	NOAA	Pacific Fisheries Environmental Laboratory (NMFS)	California	Pacific Grove
DOC	NOAA	Pacific Marine Environmental Laboratory (OAR)	Washington	Seattle
DOC	NOAA	Pascagoula Facility (NMFS)	Mississippi	Pascagoula
DOC	NOAA	Rainier research ship	Washington	Seattle
DOC	NOAA	Sandy Hook Laboratory (NMFS)	New Jersey	Highlands
DOC	NOAA	Seattle Laboratory (NMFS)	Washington	Seattle
DOC	NOAA	Space Environmental Laboratory (OAR)	Colorado	Boulder
DOC	NOAA	Stellwagen Bank National Marine Sanctuary (NOS)	Massachusetts	Scituate
DOC	NOAA	Techniques Development Laboratory (NWS)	Maryland	Silver Spring
DOC	NOAA	Tiburon (Santa Cruz) Laboratory (NMFS)	California	Santa Cruz
DOC	NOAA	Woods Hole Laboratory (NMFS)	Massachusetts	Woods Hole
DOD	Air Force	Aerospace FFRDC	California	El Segundo
DOD	Air Force	Air Force Development Test Center	Florida	Niceville
DOD	Air Force	Air Force Flight Test Center	California	Lancaster
DOD	Air Force	Air Force Office of Scientific Research	Virginia	Arlington

FEDERAL IN-HOUSE R&D ACTIVITIES BY AGENCY 633

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.		
DOD	Air Force	Air Vehicles Directorate unit (AFRL)	Florida	Panama City
DOD	Air Force	Air Vehicles Directorate Headquarters (AFRL)	Ohio	Dayton
DOD	Air Force	Arnold Engineering Development Center	Maryland	White Oak
DOD	Air Force	Arnold Engineering Development Center	Tennessee	Arnold Air Force Base
DOD	Air Force	Directed Energy Directorate (AFRL)	New Mexico	Albuquerque
DOD	Air Force	Human Effectiveness Directorate Headquarters (AFRL)	Ohio	Dayton
DOD	Air Force	Human Effectiveness Directorate unit (AFRL)	Texas	San Antonio
DOD	Air Force	Human Effectiveness Directorate Warfighter Training Research Division (AFRL)	Arizona	Mesa
DOD	Air Force	Information Directorate Headquarters (AFRL)	New York	Rome
DOD	Air Force	Information Directorate unit (AFRL)	Ohio	Dayton
DOD	Air Force	Lincoln Laboratory (FFRDC)	Massachusetts	Lexington
DOD	Air Force	Materials and Manufacturing Directorate unit (AFRL)	Florida	Panama City
DOD	Air Force	Materials and Manufacturing Directorate Headquarters (AFRL)	Ohio	Dayton
DOD	Air Force	Munitions Directorate (AFRL)	Florida	Niceville
DOD	Air Force	Project AIR FORCE (FFRDC)	California	Santa Monica
DOD	Air Force	Propulsion Directorate unit (AFRL)	California	Lancaster
DOD	Air Force	Propulsion Directorate Headquarters (AFRL)	Ohio	Dayton
DOD	Air Force	Sensors Directorate unit (AFRL)	Massachusetts	Boston
DOD	Air Force	Sensors Directorate unit (AFRL)	New York	Rome
DOD	Air Force	Sensors Directorate Headquarters (AFRL)	Ohio	Dayton
DOD	Air Force	Space Vehicles Directorate unit (AFRL)	Massachusetts	Boston
DOD	Air Force	Space Vehicles Directorate Headquarters (AFRL)	New Mexico	Albuquerque
DOD	Army	Aberdeen Proving Ground (ARL)	Maryland	Aberdeen
DOD	Army	Aberdeen Test Center	Maryland	Aberdeen
DOD	Army	Adelphi Laboratory Center (ARL)	Maryland	Adelphi
DOD	Army	Advanced Systems Directorate (MRDEC)	Alabama	Huntsville
DOD	Army	Acroflight Dynamics Directorate (AVRDEC)	California	Moffett Field
DOD	Army	Aeromedical Research Laboratory	Alabama	Dothan
DOD	Army	Air and Missile Defense Battle Laboratory	Texas	Ft. Bliss
DOD	Army	Air Maneuver Battle Laboratory	Alabama	Dothan
DOD	Army	Applied Technology Initiative (MRDEC)	Alabama	Huntsville
DOD	Army	Armament Research, Development, and Engineering Center (ARDEC) Headquarters	New Jersey	Picatinny
DOD	Army	Armed Forces Institute of Pathology	District of Columbia	
DOD	Army	Armored Forces Research Unit (ARI)	Kentucky	Ft. Knox
DOD	Army	Institute of Surgical Research	Texas	San Antonio
DOD	Army	Army Materiel Systems Analysis Activity	Maryland	Aberdeen
DOD	Army	Medical Research Institute of Infectious Disease	Maryland	Frederick
DOD	Army	Army Research Institute for the Behavioral And Social Sciences (ARI) Headquarters	Virginia	Alexandria
DOD	Army	Army Research Institute of Environmental Medicine	Massachusetts	Natick
DOD	Army	Arroyo Center (FFRDC)	California	Santa Monica
DOD	Army	Aviation Applied Technology Directorate (MRDEC)	Virginia	Fort Eustis
DOD	Army	Aviation Engineering Directorate (AVRDEC)	Alabama	Huntsville
DOD	Army	Aviation Research, Development, and Engineering Center (AVRDEC) Headquarters	Alabama	Huntsville
DOD	Army	Aviation Technical Test Center	Alabama	Dothan
DOD	Army	Battle Command Battle Laboratory	Arizona	Fort Huachuca
DOD	Army	Battle Command Battle Laboratory	Georgia	Fort Gordon
DOD	Army	Battle Command Battle Laboratory	Kansas	Ft. Leavenworth
DOD	Army	Benet Laboratories (ARDEC)	New York	Watervliet
DOD	Army	Combat Service Support Battle Laboratory	Virginia	Ft. Lee
DOD	Army	Command and Control Directorate (CECOM)	New Jersey	Eatontown
DOD	Army	Communications-Electronics Command (CECOM) Research, Development, and Engineering Center Headquarters	New Jersey	Eatontown
DOD	Army	Depth and Simultaneous Attack Battle Laboratory	Oklahoma	Ft. Sill
DOD	Army	Dismounted Battlespace Battle Laboratory	Georgia	Fort Benning
DOD	Army	Dugway Proving Ground	Utah	Dugway
DOD	Army	Edgewood Chemical Biological Center	Maryland	Aberdeen
DOD	Army	Electronic Proving Ground (WSMR)	Arizona	Fort Huachuca
DOD	Army	Engineering Directorate of (MRDEC)	Alabama	Huntsville
DOD	Army	Firing Tables Branch (ARDEC)	Maryland	Aberdeen
DOD	Army	Fort Hood Scientific Research Office (ARI)	Texas	Fort Hood

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.		
DOD	Army	Fort Leavenworth Research Unit (ARI)	Kansas	Ft. Leavenworth
DOD	Army	Fort Monmouth Facility (ARL)	New Jersey	Eatontown
DOD	Army	Ft. Bragg Scientific Research Office (ARI)	North Carolina	Ft. Bragg
DOD	Army	Georgia Institute of Technology Facility (ARL)	Georgia	Atlanta
DOD	Army	Infantry Forces Research Unit (ARI)	Georgia	Fort Benning
DOD	Army	Intelligence and Information Warfare Directorate (CECOM)	New Jersey	Eatontown
DOD	Army	Maneuver Support Battle Laboratory	Missouri	Ft. Leonard Wood
DOD	Army	Missile Guidance Directorate (MRDEC)	Alabama	Huntsville
DOD	Army	Mounted Maneuver Battlespace Battle Laboratory	Kentucky	Ft. Knox
DOD	Army	Natick Soldier Center	Massachusetts	Natick
DOD	Army	Night Vision and Electronic Sensors Directorate (CECOM)	Virginia	Fort Belvoir
DOD	Army	Operational Test and Evaluation Command	Virginia	Alexandria
DOD	Army	Propulsion and Structures Directorate (MRDEC)	Alabama	Huntsville
DOD	Army	Redstone Technical Test Center	Alabama	Huntsville
DOD	Army	Reserve Component Training Research Unit (ARI)	Idaho	Boise
DOD	Army	Rock Island Site (ARDEC)	Illinois	Rock Island
DOD	Army	Rotary-Wing Aviation Research Unit (ARI)	Alabama	Dothan
DOD	Army	Simulator Systems Research Unit (ARI)	Florida	Orlando
DOD	Army	Software Engineering Directorate (MRDEC)	Alabama	Huntsville
DOD	Army	Space and Missile Defense Battle Lab	Alabama	Huntsville
DOD	Army	Space and Missile Defense Technical Center	Alabama	Huntsville
DOD	Army	Space and Terrestrial Communications Directorate (CECOM)	New Jersey	Eatontown
DOD	Army	Systems Simulation and Development Directorate (MRDEC)	Alabama	Huntsville
DOD	Army	Tank-Automotive Research, Development, and Engineering Center	Michigan	Warren
DOD	Army	Technical Management Directorate (MRDEC)	Alabama	Huntsville
DOD	Army	TRADOC Scientific Coordination Office (ARI)	Virginia	Fort Monroe
DOD	Army	Medical Research Institute of Chemical Defense	Maryland	Aberdeen
DOD	Army	Vehicle Structures Directorate (ARL)	Virginia	Hampton
DOD	Army	Vehicle Technology Directorate (ARL)	Ohio	Cleveland
DOD	Army	Walter Reed Army Institute of Research	District of Columbia	
DOD	Army	Weapons Directorate (MRDEC)	Alabama	Huntsville
DOD	Army	White Sands Missile Range (WSMR)	New Mexico	White Sands
DOD	Army	Yuma Proving Ground	Arizona	Yuma
DOD	Corps of Engineers	Cold Regions Research and Engineering Laboratory	New Hampshire	Hanover
DOD	Corps of Engineers	Construction Engineering Research Laboratories	Illinois	Champaign-Urbana
DOD	Corps of Engineers	Hydrologic Engineering Center	California	Davis
DOD	Corps of Engineers	Topographic Engineering Center	Virginia	Alexandria
DOD	Corps of Engineers	Waterways Experiment Station	Mississippi	Vicksburg
DOD	DARPA	Defense Advanced Research Projects Agency Headquarters	Virginia	Arlington
DOD	DISA	Defense Technical Information Center Headquarters	Virginia	Fort Belvoir
DOD	DISA	Manpower and Training Research Information System	California	San Diego
DOD	DISA	Midwestern Regional Office of the DTIC	Ohio	Dayton
DOD	DISA	Northeastern Regional Office of DTIC	Massachusetts	Boston
DOD	DISA	Southwestern Regional Office of the DTIC	New Mexico	Albuquerque
DOD	DISA	Western Regional Office of DTIC	California	El Segundo
DOD	Navy	Aircraft Division (NAWC)	Maryland	Patuxent River
DOD	Navy	Aircraft Division (NAWC)	New Jersey	Lakehurst
DOD	Navy	Carderock Division (NSWC)	Maryland	Carderock
DOD	Navy	Center for Naval Analyses (CFRDC)	Virginia	Alexandria
DOD	Navy	Chesapeake Bay Detachment (NRL)	Maryland	Chesapeake Bay
DOD	Navy	Corona Division (NSWC)	California	Corona
DOD	Navy	Crane Division (NSWC)	Indiana	Crane
DOD	Navy	Dahlgren Division (NSWC)	Virginia	Dahlgren
DOD	Navy	Fleet Numerical Meteorology and Oceanography Center	California	Monterey
DOD	Navy	Flight Support Detachment (NRL)	Maryland	Lexington Park
DOD	Navy	Indian Head Division (NSWC)	Maryland	Indian Head
DOD	Navy	Keyport Division (NUWC)	Washington	Keyport
DOD	Navy	Marine Corrosion Test Facility (NRL)	Florida	Key West
DOD	Navy	Midway Research Center (NRL)	Virginia	Quantico

FEDERAL IN-HOUSE R&D ACTIVITIES BY AGENCY 635

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.)		
DOD	Navy	Naval Aerospace Medical Research Laboratory	Florida	Pensacola
DOD	Navy	Naval Dental Research Institute	Illinois	Great Lakes
DOD	Navy	Naval Facilities Engineering Services Center	California	Port Hueneme
DOD	Navy	Naval Health Research Center	California	San Diego
DOD	Navy	Naval Health Research Center Toxicology Detachment	Ohio	Dayton
DOD	Navy	Naval Medical Research Institute	Maryland	Bethesda
DOD	Navy	Naval Research Laboratory (NRL) Headquarters	District of Columbia	
DOD	Navy	Naval Submarine Medical Research Laboratory	Connecticut	Groton
DOD	Navy	Navy Clothing and Textile Research Facility	Massachusetts	Natick
DOD	Navy	Navy Personnel Research and Development Center	California	San Diego
DOD	Navy	Newport Division (NUWC)	Rhode Island	Newport
DOD	Navy	Office of Naval Research (ONR) Headquarters	Virginia	Arlington
DOD	Navy	Port Hueneme Division (NSWC)	California	Port Hueneme
DOD	Navy	R&D Management Command (ONR)	California	San Diego
DOD	Navy	R&D Management Command (ONR)	Georgia	Atlanta
DOD	Navy	R&D Management Command (ONR)	Illinois	Chicago
DOD	Navy	R&D Management Command (ONR)	Massachusetts	Boston
DOD	Navy	R&D Management Command (ONR)	Pennsylvania	Philadelphia
DOD	Navy	R&D Management Command (ONR)	Washington	Seattle
DOD	Navy	Space and Naval Warfare System Center-Charleston (SPAWAR)	South Carolina	Charleston
DOD	Navy	Space and Naval Warfare Systems (SPAWAR) Command	California	San Diego
DOD	Navy	Space and Naval Warfare Systems Center-West (SPAWAR)	California	San Diego
DOD	Navy	Stennis Space Center Site (NRL)	Mississippi	Bay St. Louis
DOD	Navy	USS <i>Shadwell</i> (NRL)	Alabama	Mobile
DOD	Navy	Weapons Division (NAWC)	California	China Lake
DOD	Navy	Weapons Division (NAWC)	California	Point Mugu
DOD	NSA	Center for Communications Research (IDAC&C FFRDC)	California	La Jolla
DOD	NSA	Center for Computing Sciences (IDAC&C FFRDC)	Maryland	Bowie
DOD	NSA	Center for Communications Research (IDAC&C FFRDC)	New Jersey	Princeton
DOD	NSA	Institute for Defense Analysis Communications and Computing (IDAC&C) FFRDC Headquarters	Virginia	Alexandria
DOD	OSD	C3 Center (C3I FFRDC)	Virginia	McLean
DOD	OSD	Command, Control, Communications, and Intelligence (C3I) FFRDC Headquarters	New Jersey	Eatontown
DOD	OSD	Fort Monmouth Facility of C3I FFRDC	Massachusetts	Bedford
DOD	OSD	Institute for Defense Analyses Studies and Analyses FFRDC	Virginia	Alexandria
DOD	OSD	Logistics Management Institute (FFRDC)	Virginia	McLean
DOD	OSD	National Defense Research Institute (FFRDC)	California	Santa Monica
DOD	OSD/AT	Software Engineering Institute (FFRDC)	Pennsylvania	Pittsburgh
DOD	USUHS	Armed Forces Radiobiology Research Institute	Maryland	Bethesda
DOE		Ames Laboratory (FFRDC)	Iowa	Ames
DOE		Argonne National Laboratory-East (FFRDC)	Illinois	Argonne
DOE		Argonne National Laboratory-West (FFRDC)	Idaho	Idaho Falls
DOE		Brookhaven National Laboratory (FFRDC)	New York	Upton
DOE		Environmental Measurement Laboratory	New York	New York
DOE		Fermi National Accelerator Laboratory (FFRDC)	Illinois	Batavia
DOE		Idaho National Engineering and Environmental Laboratory (FFRDC)	Idaho	Idaho Falls
DOE		Lawrence Berkeley National Laboratory (FFRDC)	California	Berkeley
DOE		Lawrence Livermore National Laboratory (FFRDC)	California	Livermore
DOE		Los Alamos National Laboratory (FFRDC)	New Mexico	Los Alamos
DOE		National Energy Technology Laboratory-Morgantown	West Virginia	Morgantown
DOE		National Energy Technology Laboratory-Pittsburgh	Pennsylvania	Pittsburgh
DOE		National Renewable Energy Laboratory (FFRDC)	Colorado	Golden
DOE		Oak Ridge Institute for Science and Education (FFRDC)	Tennessee	Oak Ridge
DOE		Oak Ridge National Laboratory (FFRDC)	Tennessee	Oak Ridge
DOE		Pacific Northwest National Laboratory (FFRDC)	Washington	Richland
DOE		Princeton Plasma Physics Laboratory (FFRDC)	New Jersey	Princeton
DOE		Sandia National Laboratories (FFRDC)	New Mexico	Albuquerque
DOE		Savannah River Technology Center (FFRDC)	South Carolina	Aiken
DOE		Stanford Linear Accelerator Center (FFRDC)	California	Stanford
DOE		Thomas Jefferson National Accelerator Facility (FFRDC)	Virginia	Newport News
DOI	BLM	Arthur Carhart National Wilderness Training Center	Montana	Helena
DOI	BLM	National Office of Fire and Aviation	Idaho	Boise
DOI	BLM	National Wild Horse and Burro Program	Nevada	Reno

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.)		
DOI	MMS	Pacific Outer Continental Shelf Regional Office	California	Camarillo
DOI	USGS	Alabama Cooperative Fish and Wildlife Research Unit (BRD)	Alabama	Auburn
DOI	USGS	Alabama District Office of Water Resources (WRD)	Alabama	Montgomery
DOI	USGS	Alaska Biological Science Center (BRD)	Alaska	Anchorage
DOI	USGS	Alaska Cooperative Fish and Wildlife Research Unit (BRD)	Alaska	Fairbanks
DOI	USGS	Alaska District Office of Water Resources (WRD)	Alaska	Anchorage
DOI	USGS	Arid Lands Field Station (BRD)	New Mexico	Albuquerque
DOI	USGS	Arizona Cooperative Fish and Wildlife Research Unit (BRD)	Arizona	Tucson
DOI	USGS	Arizona District Office of Water Resources (WRD)	Arizona	Tucson
DOI	USGS	Arkansas Cooperative Fish and Wildlife Research Unit (BRD)	Arkansas	Fayetteville
DOI	USGS	Arkansas District Office of Water Resources (WRD)	Arkansas	Little Rock
DOI	USGS	Arkansas Field Station (BRD)	Arkansas	Fayetteville
DOI	USGS	Aviation Management Program	Georgia	Atlanta
DOI	USGS	Biological Survey Project of Patuxent Wildlife Research Center (BRD)	District of Columbia	
DOI	USGS	Biological Resources Division Central Regional Office (BRD)	Colorado	Denver
DOI	USGS	Biological Resources Division Eastern Regional Office (BRD)	West Virginia	Kearneysville
DOI	USGS	Biological Resources Division Headquarters (BRD)	Virginia	Reston
DOI	USGS	Biological Resources Division Western Regional Office (BRD)	Washington	Seattle
DOI	USGS	Brazos Field Research Station (BRD)	Texas	College Station
DOI	USGS	California Cooperative Fishery Unit (BRD)	California	Arcata
DOI	USGS	California District Office of Water Resources (WRD)	California	Sacramento
DOI	USGS	Canyonlands Field Station (BRD)	Utah	Moab
DOI	USGS	Cascadia Field Station (BRD)	Washington	Seattle
DOI	USGS	Center for Biological Informatics (BRD)	Colorado	Denver
DOI	USGS	Center for Coastal Geology and Regional Marine Studies (GEO)	Florida	St. Petersburg
DOI	USGS	Colorado Cooperative Fish and Wildlife Research Unit (BRD)	Colorado	Fort Collins
DOI	USGS	Colorado District Office of Water Resources (WRD)	Colorado	Lakewood
DOI	USGS	Colorado Plateau Field Station (BRD)	Arizona	Flagstaff
DOI	USGS	Columbia Environmental Research Center (BRD)	Missouri	Columbia
DOI	USGS	Columbia Field Station (BRD)	Missouri	Columbia
DOI	USGS	Columbia River Research Laboratory (BRD)	Washington	Cook
DOI	USGS	Columbus Field Research Station (BRD)	Ohio	Columbus
DOI	USGS	Connecticut District Office of Water Resources (WRD)	Connecticut	East Hartford
DOI	USGS	Corpus Christi Field Station (BRD)	Texas	Corpus Christi
DOI	USGS	Delaware District Office of Water Resources (WRD)	Delaware	Dover
DOI	USGS	Denver Field Office of Mid-Continent Ecological Science Center (BRD)	Colorado	Denver
DOI	USGS	Earth Resources Observation Systems (EROS) Data Center (NMD)	South Dakota	Sioux Falls
DOI	USGS	Florida Caribbean Fish and Wildlife Research Unit (BRD)	Florida	Gainesville
DOI	USGS	Florida Cooperative Fish and Wildlife Research Unit (BRD)	Florida	Gainesville
DOI	USGS	Florida District Office of Water Resources (WRD)	Florida	Tallahassee
DOI	USGS	Forest And Rangeland Ecosystem Science Center (BRD)	Oregon	Corvallis
DOI	USGS	Geologic Central Regional Office (GEO)	Colorado	Denver
DOI	USGS	Geologic Eastern Regional Office (GEO)	Virginia	Reston
DOI	USGS	Geologic Western Regional Office (GEO)	California	Menlo Park
DOI	USGS	Georgia Cooperative Fish and Wildlife Research Unit (BRD)	Georgia	Athens
DOI	USGS	Georgia District Office of Water Resources (WRD)	Georgia	Atlanta
DOI	USGS	Glacier Field Station (BRD)	Montana	West Glacier
DOI	USGS	Grambling Wildlife Project (BRD)	Louisiana	Grambling
DOI	USGS	Great Lakes Science Center (BRD)	Michigan	Ann Arbor
DOI	USGS	Great Smokey Mountains Field Station (BRD)	Tennessee	Gatlinburg
DOI	USGS	Greater Yellowstone Field Station (BRD)	Montana	Bozeman
DOI	USGS	Grizzly Bear Ecology Office (BRD)	Idaho	Moscow
DOI	USGS	Haleakala National Park Field Station (BRD)	Hawaii	Makawao
DOI	USGS	Hawaii Cooperative Fishery Research Unit (BRD)	Hawaii	Honolulu
DOI	USGS	Hawaii District Office of Water Resources (WRD)	Hawaii	Honolulu
DOI	USGS	Honolulu Field Station of National Wildlife Health Center (BRD)	Hawaii	Honolulu
DOI	USGS	Idaho Cooperative Fish and Wildlife Research Unit (BRD)	Idaho	Moscow
DOI	USGS	Idaho District Office of Water Resources (WRD)	Idaho	Boise
DOI	USGS	Illinois District Office of Water Resources (WRD)	Illinois	Urbana
DOI	USGS	Indiana District Office of Water Resources (WRD)	Indiana	Indianapolis
DOI	USGS	International Falls Biological Station (BRD)	Minnesota	International Falls

FEDERAL IN-HOUSE R&D ACTIVITIES BY AGENCY 637

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.)		
DOI	USGS	Iowa Cooperative Fish and Wildlife Research Unit (BRD)	Iowa	Ames
DOI	USGS	Iowa District Office of Water Resources (WRD)	Iowa	Iowa City
DOI	USGS	Jackson Field Research Station (BRD)	Wyoming	Jackson Hole
DOI	USGS	Jemez Mountains Field Station (BRD)	New Mexico	Los Alamos
DOI	USGS	Kansas Cooperative Fish and Wildlife Research Unit (BRD)	Kansas	Manhattan
DOI	USGS	Kansas District Office of Water Resources (WRD)	Kansas	Lawrence
DOI	USGS	Kentucky District Office of Water Resources (WRD)	Kentucky	Louisville
DOI	USGS	Kilauea Field Station of Pacific Island Ecosystems Center (BRD)	Hawaii	Kilauea
DOI	USGS	Lake Erie Biological Station (BRD)	Ohio	Sandusky
DOI	USGS	Lake Michigan Ecological Station (BRD)	Indiana	Porter
DOI	USGS	Lake Ontario Biological Station (BRD)	New York	Oswego
DOI	USGS	Lake Superior Biological Station (BRD)	Wisconsin	Ashland
DOI	USGS	Las Vegas Field Station (BRD)	Nevada	Las Vegas
DOI	USGS	Leetown Science Center (BRD)	West Virginia	Leetown
DOI	USGS	Louisiana Cooperative Fish and Wildlife Research Unit (BRD)	Louisiana	Baton Rouge
DOI	USGS	Louisiana District Office of Water Resources (WRD)	Louisiana	Baton Rouge
DOI	USGS	Maine Cooperative Fish and Wildlife Research Unit (BRD)	Maine	Orono
DOI	USGS	Maine District Office of Water Resources (WRD)	Maine	Augusta
DOI	USGS	Manoa Field Station of Pacific Island Ecosystems Research Center (BRD)	Hawaii	Honolulu
DOI	USGS	Mapping Applications Center (NMD)	Virginia	Reston
DOI	USGS	Marrowstone Marine Field Laboratory (BRD)	Washington	Nordland
DOI	USGS	Maryland Cooperative Fish and Wildlife Unit (BRD)	Maryland	Princess Anne
DOI	USGS	Maryland District Office of Water Resources (WRD)	Maryland	Baltimore
DOI	USGS	Massachusetts Cooperative Fish and Wildlife Research Unit (BRD)	Massachusetts	Amherst
DOI	USGS	Massachusetts District Office of Water Resources (WRD)	Massachusetts	Northborough
DOI	USGS	Michigan District Office of Water Resources (WRD)	Michigan	Lansing
DOI	USGS	Mid-Continent Mapping Center (NMD)	Missouri	Rolla
DOI	USGS	Midcontinent Ecological Science Center (BRD)	Colorado	Fort Collins
DOI	USGS	Migratory Birds Field Station (BRD)	Maine	Orono
DOI	USGS	Minnesota Cooperative Fish and Wildlife Research Unit (BRD)	Minnesota	St. Paul
DOI	USGS	Minnesota District Office of Water Resources (WRD)	Minnesota	Mounds View
DOI	USGS	Minnesota Field Station (BRD)	Minnesota	St. Paul
DOI	USGS	Mississippi Cooperative Fish and Wildlife Research Unit (BRD)	Mississippi	Starkville
DOI	USGS	Mississippi District Office of Water Resources (WRD)	Mississippi	Pearl
DOI	USGS	Missouri Cooperative Fish and Wildlife Research Unit (BRD)	Missouri	Columbia
DOI	USGS	Missouri District Office of Water Resources (WRD)	Missouri	Rolla
DOI	USGS	Montana Cooperative Fishery Research Unit (BRD)	Montana	Bozeman
DOI	USGS	Montana Cooperative Wildlife Research Unit (BRD)	Montana	Missoula
DOI	USGS	Montana District Office of Water Resources (WRD)	Montana	Helena
DOI	USGS	National Mapping Division Headquarters (see Mapping Applications Center) (NMD)	Virginia	Reston
DOI	USGS	National Wetlands Research Center (BRD)	Louisiana	Lafayette
DOI	USGS	National Wildlife Health Center (BRD)	Wisconsin	Madison
DOI	USGS	Nebraska District Office of Water Resources (WRD)	Nebraska	Lincoln
DOI	USGS	Nevada District Office of Water Resources (WRD)	Nevada	Carson City
DOI	USGS	New Hampshire District Office of Water Resources (WRD)	New Hampshire	Pembroke
DOI	USGS	New Jersey District Office of Water Resources (WRD)	New Jersey	West Trenton
DOI	USGS	New Mexico Cooperative Fish and Wildlife Research Unit (BRD)	New Mexico	Las Cruces
DOI	USGS	New Mexico District Office of Water Resources (WRD)	New Mexico	Albuquerque
DOI	USGS	New York Cooperative Fish and Wildlife Research Unit (BRD)	New York	Ithaca
DOI	USGS	New York District Office of Water Resources (WRD)	New York	Troy
DOI	USGS	North Atlantic Field Station (BRD)	Massachusetts	Boston
DOI	USGS	North Carolina Cooperative Fish and Wildlife Research Unit (BRD)	North Carolina	Raleigh
DOI	USGS	North Carolina District Office of Water Resources (WRD)	North Carolina	Raleigh
DOI	USGS	North Dakota District Office of Water Resources (WRD)	North Dakota	Bismark
DOI	USGS	Northern Prairie Wildlife Research Center (BRD)	North Dakota	Jamestown
DOI	USGS	Northern Rocky Mountain Science Center (BRD)	Montana	Bozeman
DOI	USGS	Ohio Cooperative Fish and Wildlife Research Unit (BRD)	Ohio	Columbus
DOI	USGS	Ohio District Office of Water Resources (WRD)	Ohio	Columbus
DOI	USGS	Oklahoma Cooperative Fish and Wildlife Research Unit (BRD)	Oklahoma	Stillwater
DOI	USGS	Oklahoma District Office of Water Resources (WRD)	Oklahoma	Oklahoma City

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.		
DOI	USGS	Olympic Field Station (BRD)	Washington	Port Angeles
DOI	USGS	Oregon Cooperative Fish and Wildlife Research Units (BRD)	Oregon	Corvallis
DOI	USGS	Oregon District Office of Water Resources (WRD)	Oregon	Portland
DOI	USGS	Orono Field Station (BRD)	Maine	Orono
DOI	USGS	Pacific Island Ecosystems Research Center (BRD)	Hawaii	Honolulu
DOI	USGS	Padre Island Field Research Station (BRD)	Texas	Corpus Christi
DOI	USGS	Patuxent Wildlife Research Center (BRD)	Maryland	Princess Anne
DOI	USGS	Pennsylvania Cooperative Fish and Wildlife Research Unit (BRD)	Pennsylvania	Pittsburgh
DOI	USGS	Pennsylvania District Office of Water Resources (WRD)	Pennsylvania	Lemoyne
DOI	USGS	Puerto Rico District Office of Water Resources (WRD)	Puerto Rico	Guaynabo
DOI	USGS	Regional Ecosystem Office of the Forest and Rangeland Ecosystem Science Center (BRD)	Oregon	Portland
DOI	USGS	Reno Field Station (BRD)	Nevada	Reno
DOI	USGS	Rocky Mountain Mapping Center (NMD)	Colorado	Denver
DOI	USGS	Seismological Laboratory	New Mexico	Albuquerque
DOI	USGS	Silvio O. Conte Anadromous Fish Research Laboratory (BRD)	Massachusetts	Turner Falls
DOI	USGS	Snake River Field Station (BRD)	Idaho	Boise
DOI	USGS	South Carolina Cooperative Fish and Wildlife Research Unit (BRD)	South Carolina	Clemson
DOI	USGS	South Carolina District Office of Water Resources (WRD)	South Carolina	Columbia
DOI	USGS	South Dakota Cooperative Fish and Wildlife Research Unit (BRD)	South Dakota	Brookings
DOI	USGS	South Dakota District Office of Water Resources (WRD)	South Dakota	Rapid City
DOI	USGS	Southeast Field Station (BRD)	Georgia	Athens
DOI	USGS	Southern Appalachian Field Laboratory (BRD)	Tennessee	Knoxville
DOI	USGS	St. George Field Station (BRD)	Utah	Saint George
DOI	USGS	Tennessee Cooperative Fishery Research Unit (BRD)	Tennessee	Cookeville
DOI	USGS	Tennessee District Office of Water Resources (WRD)	Tennessee	Nashville
DOI	USGS	Texas Cooperative Fish and Wildlife Research Unit (BRD)	Texas	Lubbock
DOI	USGS	Texas District Office of Water Resources (WRD)	Texas	Austin
DOI	USGS	Tunison Laboratory of Aquatic Sciences Field Station (BRD)	New York	Cortland
DOI	USGS	Upper Midwest Environmental Sciences Center (BRD)	Wisconsin	La Crosse
DOI	USGS	Utah Cooperative Fish and Wildlife Research Unit (BRD)	Utah	Logan
DOI	USGS	Utah District Office of Water Resources (WRD)	Utah	West Valley City
DOI	USGS	Vermont Cooperative Fish and Wildlife Research Unit (BRD)	Vermont	Burlington
DOI	USGS	Vicksburg Field Station (BRD)	Mississippi	Vicksburg
DOI	USGS	Virginia Cooperative Fish and Wildlife Research Unit (BRD)	Virginia	Blacksburg
DOI	USGS	Virginia District Office of Water Resources (WRD)	Virginia	Richmond
DOI	USGS	Washington Cooperative Fish and Wildlife Research Unit (BRD)	Washington	Seattle
DOI	USGS	Washington District Office of Water Resources (WRD)	Washington	Tacoma
DOI	USGS	Wellsboro Research and Development Laboratory (BRD)	Pennsylvania	Wellsboro
DOI	USGS	West Virginia Cooperative Fish and Wildlife Research Unit (BRD)	West Virginia	Morgantown
DOI	USGS	West Virginia District Office of Water Resources (WRD)	West Virginia	Charleston
DOI	USGS	Western Ecological Research Center (BRD)	California	Sacramento
DOI	USGS	Western Fisheries Research Center (BRD)	Washington	Seattle
DOI	USGS	Western Mapping Center (NMD)	California	Menlo Park
DOI	USGS	Western Regional Coastal and Marine Geology Center (see Geologic Western Regional Office) (GEO)	California	Menlo Park
DOI	USGS	Wisconsin Cooperative Fishery Research Unit (BRD)	Wisconsin	Stevens Point
DOI	USGS	Wisconsin Cooperative Wildlife Research Unit (BRD)	Wisconsin	Madison
DOI	USGS	Wisconsin District Office of Water Resources (WRD)	Wisconsin	Middleton
DOI	USGS	Woods Hole Geology Field Center	Massachusetts	Woods Hole
DOI	USGS	Wyoming Cooperative Fish and Wildlife Research Unit (BRD)	Wyoming	Laramie
DOI	USGS	Wyoming District Office of Water Resources (WRD)	Wyoming	Cheyenne
DOI	USGS	Yankton Field Research Station (BRD)	South Dakota	Sioux Falls
DOJ		Federal Bureau of Investigation Laboratory	District of Columbia	
DOJ		National Institute of Justice	District of Columbia	
DOT	Coast Guard	Fire and Safety Test Detachment of Coast Guard Research and Development Center	Alabama	Mobile
DOT	Coast Guard	U.S. Coast Guard Research and Development Center	Connecticut	Groton
DOT	FAA	Civil Aeromedical Institute	Oklahoma	Oklahoma City

FEDERAL IN-HOUSE R&D ACTIVITIES BY AGENCY 639

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.		
DOT	FAA	William J. Hughes Technical Center	New Jersey	Atlantic City
DOT	FAA	Center for Advanced Aviation System Development (FFRDC)	Virginia	McLean
DOT	FHWA	Turner-Fairbank Highway Research Center	Virginia	McLean
DOT	NHTSA	Vehicle Research and Test Center	Ohio	East Liberty
DOT	RSPA	John A. Volpe National Transportation Systems Center	Massachusetts	Cambridge
DOT		Department of Transportation Headquarters	District of Columbia	
DVA		Baltimore VA Medical Center	Maryland	Baltimore
DVA		Birmingham VA Medical Center	Alabama	Birmingham
DVA		Boise VA Medical Center	Idaho	Boise
DVA		Boston VA Medical Center	Massachusetts	Boston
DVA		Brockton VA Medical Center	Massachusetts	Brockton
DVA		Bronx VA Medical Center	New York	Bronx
DVA		Carl T. Hayden VA Medical Center	Arizona	Phoenix
DVA		Cincinnati VA Medical Center	Ohio	Cincinnati
DVA		Clement J. Zablocki VA Medical Center	Wisconsin	Milwaukee
DVA		Dallas VA Medical Center	Texas	Dallas
DVA		Dayton VA Medical Center	Ohio	Dayton
DVA		Denver VA Medical Center	Colorado	Denver
DVA		Durham VA Medical Center	North Carolina	Durham
DVA		DVA Medical Center	Michigan	Ann Arbor
DVA		East Orange Campus of the VA New Jersey Health Care System	New Jersey	East Orange
DVA		Edith Nourse Rogers Memorial Veterans Hospital	Massachusetts	Bedford
DVA		Fargo VA Medical Center	North Dakota	Fargo
DVA		Gainesville Division of the North Florida/South Georgia Veterans Healthcare System	Florida	Gainesville
DVA		Great Lakes Health Care System/Edward Hines Jr. Hospital (VA Medical Center)	Illinois	Hines
DVA		Hampton VA Medical Center	Virginia	Hampton
DVA		Harry S. Truman Memorial VA Medical Center	Missouri	Columbia
DVA		Honolulu VA Medical Center	Hawaii	Honolulu
DVA		Houston VA Medical Center	Texas	Houston
DVA		Hunter Holmes McGuire VA Medical Center	Virginia	Richmond
DVA		Huntington VA Medical Center	West Virginia	Huntington
DVA		Iowa City VA Medical Center	Iowa	Iowa City
DVA		Jackson VA Medical Center	Mississippi	Jackson
DVA		John D. Dingell VA Medical Center	Michigan	Detroit
DVA		John L. McLellan Memorial Hospital (VA Medical Center)	Arkansas	Little Rock
DVA		Lexington VA Medical Center	Kentucky	Lexington
DVA		Louis Al Johnson VA Medical Center	West Virginia	Clarksburg
DVA		Louis Stokes VA Medical Center	Ohio	Cleveland
DVA		Louisville VA Medical Center	Kentucky	Louisville
DVA		Manchester VA Medical Center	New Hampshire	Manchester
DVA		Memphis VA Medical Center	Tennessee	Memphis
DVA		Miami VA Medical Center	Florida	Miami
DVA		Minneapolis VA Medical Center	Minnesota	Minneapolis
DVA		Mountain Home VA Medical Center	Tennessee	Johnson City
DVA		Nashville VA Medical Center	Tennessee	Nashville
DVA		New Mexico VA Health Care System Facility	New Mexico	Albuquerque
DVA		New Orleans VA Medical Center	Louisiana	New Orleans
DVA		New York VA Medical Center	New York	New York
DVA		Oklahoma City VA Medical Center	Oklahoma	Oklahoma City
DVA		Omaha VA Medical Center	Nebraska	Omaha
DVA		Philadelphia VA Medical Center	Pennsylvania	Philadelphia
DVA		Portland VA Medical Center	Oregon	Portland
DVA		Providence VA Medical Center	Rhode Island	Providence
DVA		Ralph H. Johnson VA Medical Center	South Carolina	Charleston
DVA		Richard L. Roudebush VA Medical Center	Indiana	Indianapolis
DVA		Salem VA Medical Center	Virginia	Salem
DVA		Salisbury-W.G. Hefner VA Medical Center	North Carolina	Salisbury
DVA		San Francisco VA Medical Center	California	San Francisco
DVA		San Juan VA Medical Center	Puerto Rico	San Juan
DVA		Shreveport VA Medical Center	Louisiana	Shreveport
DVA		South Texas Veterans Health Care System	Texas	San Antonio

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.)		
DVA		VA Connecticut Healthcare System	Connecticut	West Haven
DVA		VA Greater Los Angeles Healthcare System	California	Los Angeles
DVA		VA Medical Center	Arizona	Tucson
DVA		VA Medical Center	California	Fresno
DVA		VA Medical Center	California	Loma Linda
DVA		VA Medical Center	California	Long Beach
DVA		VA Medical Center	California	Pleasant Hill
DVA		VA Medical Center	California	Sepulveda
DVA		VA Medical Center	Florida	Bay Pines
DVA		VA Medical Center	Florida	Tampa
DVA		VA Medical Center	Georgia	Decatur
DVA		VA Medical Center	Illinois	Chicago
DVA		VA Medical Center	Illinois	Danville
DVA		VA Medical Center	Missouri	St. Louis
DVA		VA Medical Center	New York	Bath
DVA		VA Medical Center	New York	Brooklyn
DVA		VA Medical Center	New York	Buffalo
DVA		VA Medical Center	New York	Canandaigua
DVA		VA Medical Center	New York	Northport
DVA		VA Medical Center	New York	Syracuse
DVA		VA Medical Center	Pennsylvania	Coatesville
DVA		VA Medical Center	Pennsylvania	Lebanon
DVA		VA Medical Center	Texas	Temple
DVA		VA Medical Center	Georgia	Augusta
DVA		VA Medical Center	Missouri	Kansas City
DVA		VA Medical Center	New York	Albany
DVA		VA Medical Center	Texas	Amarillo
DVA		VA Medical Centers	Pennsylvania	Pittsburgh
DVA		VA Palo Alto Health Care System	California	Palo Alto
DVA		VA Puget Sound Health Care System	Washington	Seattle
DVA		VA Salt Lake City Health Care System	Utah	Salt Lake City
DVA		VA San Diego Healthcare System	California	San Diego
DVA		VA Sierra Nevada Health Care System, VA Medical Center in Reno	Nevada	Reno
DVA		Washington, D.C. VA Medical Center	District of Columbia	
DVA		White River Junction VA Medical Center	Vermont	White River Junction
DVA		Wichita VA Medical Center	Kansas	Wichita
DVA		William Jennings Bryan Dorn Veteran's Hospital	South Carolina	Columbia
DVA		William S. Middleton VA Medical Center	Wisconsin	Madison
EPA	NCEA	National Center for Environmental Assessment (NCEA) Headquarters	District of Columbia	
EPA	NCEA	National Center for Environmental Assessment Office	North Carolina	Research Triangle Park
EPA	NCEA	National Center for Environmental Assessment Office	Ohio	Cincinnati
EPA	NCERQA	National Center for Environmental Research and Quality Assurance	District of Columbia	
EPA	NERL	Ecological Exposure Research Division	Ohio	Cincinnati
EPA	NERL	Ecosystems Research Division	Georgia	Athens
EPA	NERL	Environmental Sciences Division	Nevada	Reno
EPA	NERL	Microbiological and Chemical Exposure Assessment Research Division	Ohio	Cincinnati
EPA	NERL	National Exposure Research Laboratory (NERL) Headquarters	North Carolina	Research Triangle Park
EPA	NHEERL	Atlantic Ecology Division	Rhode Island	Narragansett
EPA	NHEERL	Gulf Ecology Division	Florida	Gulf Breeze
EPA	NHEERL	Large Lakes Research Station	Michigan	Grosse Ile
EPA	NHEERL	Mid-Continent Ecology Division	Minnesota	Duluth
EPA	NHEERL	National Health and Environmental Effects Research Laboratory (NHEERL) Headquarters	North Carolina	Research Triangle Park
EPA	NHEERL	Western Ecology Division	Oregon	Corvallis
EPA	NRML	Air Pollution Prevention and Control Division	North Carolina	Research Triangle Park
EPA	NRML	National Risk Management Research Laboratory (NRML) Headquarters	Ohio	Cincinnati
EPA	NRML	Subsurface Protection and Remediation Division	Oklahoma	Ada

FEDERAL IN-HOUSE R&D ACTIVITIES BY AGENCY 641

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.)		
HHS	ATSDR	Agency for Toxic Substances and Disease Registry Headquarters	Georgia	Atlanta
HHS	CDC	Arctic Investigations Program (NCID)	Alaska	Anchorage
HHS	CDC	Biomedical and Behavioral Sciences Division (NIOSH)	Ohio	Cincinnati
HHS	CDC	Dengue Branch of the Division of Vector-Borne Infectious Diseases (NCID)	Puerto Rico	San Juan
HHS	CDC	Division of Physical Sciences and Engineering (NIOSH)	Ohio	Cincinnati
HHS	CDC	Division of Respiratory Diseases Studies (NIOSH)	West Virginia	Morgantown
HHS	CDC	Division of Safety Research (NIOSH)	West Virginia	Morgantown
HHS	CDC	Division of Surveillance Hazards Evaluations and Field Studies (NIOSH)	Ohio	Cincinnati
HHS	CDC	Division of Vector-Borne Infectious Diseases (NCID)	Colorado	Fort Collins
HHS	CDC	Education and Information Division (NIOSH)	Ohio	Cincinnati
HHS	CDC	Epidemiology Program Office	Georgia	Atlanta
HHS	CDC	Health Effects Laboratory (NIOSH)	West Virginia	Morgantown
HHS	CDC	National Center for Chronic Disease Prevention and Health Promotion	Georgia	Atlanta
HHS	CDC	National Center for Environmental Health	Georgia	Atlanta
HHS	CDC	National Center for Infectious Diseases (NCID) Headquarters	Georgia	Atlanta
HHS	CDC	National Center for Injury Prevention and Control	Georgia	Atlanta
HHS	CDC	National Immunization Program	Georgia	Atlanta
HHS	CDC	Physical Sciences and Engineering Division (NIOSH)	Ohio	Cincinnati
HHS	CDC	Pittsburgh Research Laboratory (NIOSH)	Pennsylvania	Pittsburgh
HHS	CDC	Public Health Program Office	Georgia	Atlanta
HHS	CDC	Spokane Research Center (NIOSH)	Washington	Spokane
HHS	CDC	Surveillance Hazards Evaluations and Field Studies Division (NIOSH)	Ohio	Cincinnati
HHS	FDA	Animal Drug Research Center	Colorado	Denver
HHS	FDA	Center for Biologics Evaluation and Research	Maryland	Rockville
HHS	FDA	Center for Devices and Radiological Health	Maryland	Rockville
HHS	FDA	Center for Drug Evaluation and Research	Maryland	Rockville
HHS	FDA	Center for Food Safety and Applied Nutrition	District of Columbia	
HHS	FDA	Center for Veterinary Medicine	Maryland	Rockville
HHS	FDA	Central Laboratory for Microbiological Investigations	Minnesota	Minneapolis
HHS	FDA	Dallas District Laboratory	Texas	Dallas
HHS	FDA	Detroit District Laboratory	Michigan	Detroit
HHS	FDA	Forensic Chemistry Center	Ohio	Cincinnati
HHS	FDA	Minneapolis District Laboratory	Minnesota	Minneapolis
HHS	FDA	National Center for Toxicological Research	Arkansas	Jefferson
HHS	FDA	Northeast Regional Laboratory	New York	Brooklyn
HHS	FDA	Pacific Regional Laboratory-Southwest	California	Los Angeles
HHS	FDA	Philadelphia District Laboratory	Pennsylvania	Philadelphia
HHS	FDA	San Juan District Laboratory	Puerto Rico	San Juan
HHS	FDA	Seafood Product Research Center	Washington	Bothell
HHS	FDA	Southeast Regional Laboratory	Georgia	Atlanta
HHS	FDA	Total Diet Pesticide Research Center	Kansas	Lenexa
HHS	FDA	Winchester Engineering and Analytical Center	Massachusetts	Winchester
HHS	NIH	Fogarty International Center	Maryland	Bethesda
HHS	NIH	Frederick Cancer Research and Development Center (FFRDC)	Maryland	Frederick
HHS	NIH	National Cancer Institute	Maryland	Bethesda
HHS	NIH	National Center for Complementary and Alternative Medicine	Maryland	Bethesda
HHS	NIH	National Center for Research Resources	Maryland	Bethesda
HHS	NIH	National Eye Institute	Maryland	Bethesda
HHS	NIH	National Heart, Lung, and Blood Institute	Maryland	Bethesda
HHS	NIH	National Human Genome Institute	Maryland	Bethesda
HHS	NIH	National Institute on Drug Abuse	Maryland	Bethesda
HHS	NIH	National Institute on Aging	Maryland	Bethesda
HHS	NIH	National Institute on Alcohol Abuse and Alcoholism	Maryland	Bethesda
HHS	NIH	National Institute of Allergy and Infectious Diseases (NIAID)	Maryland	Bethesda
HHS	NIH	National Institute of Arthritis and Musculoskeletal and Skin Diseases	Maryland	Bethesda
HHS	NIH	National Institute of Child Health and Human Development	Maryland	Bethesda
HHS	NIH	National Institute on Deafness and Other Communication Disorders	Maryland	Bethesda
HHS	NIH	National Institute of Dental and Craniofacial Research	Maryland	Bethesda
HHS	NIH	National Institute of Diabetes and Digestive and Kidney Diseases (NIDDKD)	Maryland	Bethesda

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.		
HHS	NIH	National Institute of Environmental Health Sciences	North Carolina	Research Triangle Park
HHS	NIH	National Institute of General Medical Sciences	Maryland	Bethesda
HHS	NIH	National Institute of Mental Health	Maryland	Bethesda
HHS	NIH	National Institute of Neurological Disorders and Stroke	Maryland	Bethesda
HHS	NIH	National Institute of Nursing Research	Maryland	Bethesda
HHS	NIH	National Library of Medicine	Maryland	Bethesda
HHS	NIH	Office of AIDS Research	Maryland	Bethesda
HHS	NIH	Office of the Director of NIH	Maryland	Bethesda
HHS	NIH	Phoenix Epidemiology and Clinical Research Branch (NIDDKD)	Arizona	Phoenix
HHS	NIH	Rocky Mountain Laboratories (NIAID)	Montana	Hamilton
NASA		Ames Research Center	California	Moffett Field
NASA		Dryden Flight Research Center	California	Langley
NASA		George C. Marshall Space Flight Center	Alabama	Huntsville
NASA		Glenn Research Center	Ohio	Cleveland
NASA		Goddard Institute for Space Studies	New York	New York
NASA		Goddard Space Flight Center	Maryland	Greenbelt
NASA		Jet Propulsion Laboratory (FFRDC)	California	Pasadena
NASA		John C. Stennis Space Center	Mississippi	Bay St. Louis
NASA		John F. Kennedy Space Center	Florida	Cape Canaveral
NASA		Langley Research Center	Virginia	Hampton
NASA		Lyndon B. Johnson Space Center	Texas	Houston
NASA		NASA Headquarters	District of Columbia	
NASA		Wallops Flight Facility	Virginia	Wallops Island
NASA		White Sands Test Facility	New Mexico	Las Cruces
NRC		Center for Nuclear Waste Regulatory Analyses (FFRDC)	Texas	San Antonio
NSF		Arecibo Radio Telescope (NAIC) (FFRDC)	Puerto Rico	Arecibo
NSF		Gemini Observatories (NOAO) (FFRDC)	Hawaii	Mauna Kea
NSF		Green Bank Telescope (NRAO) (FFRDC)	West Virginia	Green Bank
NSF		Kitt Peak Observatory (NRAO) (FFRDC)	Arizona	Tucson
NSF		National Astronomy and Ionosphere Center (NAIC) Headquarters (FFRDC)	New York	Ithaca
NSF		National Center for Atmospheric Research (FFRDC)	Colorado	Boulder
NSF		National Optical Astronomy Observatories (NOAO) Headquarters (FFRDC)	Arizona	Tucson
NSF		National Radio Astronomy Observatory (NRAO) Headquarters (FFRDC)	Virginia	Charlottesville
NSF		Radio Astronomy Antennas (NRAO) (FFRDC)	New Mexico	Socorro
NSF		Science and Technology Policy Institute (FFRDC)	District of Columbia	
NSF		Solar Observatory (NOAO) (FFRDC)	New Mexico	Sunspot
Smithsonian		Anacostia Museum and Center for African American History and Culture	District of Columbia	
Smithsonian		Archives of American Art	District of Columbia	
Smithsonian		Arthur M. Sackler Gallery/Freer Gallery of Art	District of Columbia	
Smithsonian		Astrophysical Observatory	Massachusetts	Cambridge
Smithsonian		Center for Materials Research and Education	Maryland	Suitland
Smithsonian		Centers for Folklife Programs and Cultural Studies	District of Columbia	
Smithsonian		Cooper-Hewitt National Design Museum	New York	New York
Smithsonian		Environmental Research Center	Maryland	Edgewater
Smithsonian		Hirshhorn Museum and Sculpture Garden	District of Columbia	
Smithsonian		National Air & Space Museum	District of Columbia	
Smithsonian		National Museum of African Art	District of Columbia	
Smithsonian		National Museum of American Art	District of Columbia	
Smithsonian		National Museum of American History	District of Columbia	
Smithsonian		National Museum of Natural History	District of Columbia	
Smithsonian		National Museum of the American Indian	New York	New York

FEDERAL IN-HOUSE R&D ACTIVITIES BY AGENCY 643

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
		(Note: Only those federal units where federal R&D funds are actually being spent in-house (i.e., on-site) are listed. This means that the headquarters units of some federal agencies and bureaus are not included in the list as the activities taking place at these locations have been deemed by the respective federal agencies and/or bureaus to NOT be R&D and have not been so reported to OMB. These activities are, therefore, not part of the official federal R&D budget.		
Smithsonian		National Postal Museum	District of Columbia	
Smithsonian		National Zoological Park Conservation and Research Center	Virginia	Front Royal
Smithsonian		Smithsonian Institution Archives	District of Columbia	
Smithsonian		Smithsonian Institution Libraries	District of Columbia	
Smithsonian		West Coast Research Center	California	San Marino
TREA		Center for Strategic Tax Administration Modernization (FPRDC)	Virginia	McLean
TVA		Environmental Research Center	Alabama	Muscle Shoals
USDA	APHIS	National Wildlife Research Center	Colorado	Fort Collins
USDA	ARS	Agricultural Research Service Headquarters	District of Columbia	
USDA	ARS	Appalachian Farming Systems Research Center	West Virginia	Beckley
USDA	ARS	Appalachian Fruit Research Station	West Virginia	Kearneysville
USDA	ARS	Aquaculture Systems Research Laboratory	Arkansas	Pine Bluff
USDA	ARS	Aquatic Weed Control Research Laboratory	Florida	Fort Lauderdale
USDA	ARS	Arkansas Children's Nutrition Center	Arkansas	Little Rock
USDA	ARS	ARS Facility at the University of Nebraska	Nebraska	Lincoln
USDA	ARS	ARS Research Facility at Iowa State University	Iowa	Ames
USDA	ARS	ARS Research Facility at Michigan State University	Michigan	East Lansing
USDA	ARS	ARS Research Facility at North Carolina State University	North Carolina	Raleigh
USDA	ARS	ARS Research Facility at Ohio Agricultural R&D Center	Ohio	Wooster
USDA	ARS	ARS Research Facility at Purdue University	Indiana	West Lafayette
USDA	ARS	ARS Research Facility at the University of California at Davis	California	Davis
USDA	ARS	ARS Research Facility at the University of Minnesota	Minnesota	St. Paul
USDA	ARS	ARS Research Facility at the University of Missouri	Missouri	Columbia
USDA	ARS	ARS Research Facility at University of Illinois	Illinois	Champaign-Urbana
USDA	ARS	Arthropod-Borne Animal Diseases Research Laboratory	Wyoming	Laramie
USDA	ARS	Avian Disease and Oncology Laboratory	Michigan	East Lansing
USDA	ARS	Beltsville Agricultural Research Center	Maryland	Beltsville
USDA	ARS	Beneficial Insects Research Laboratory	Delaware	Newark
USDA	ARS	Biological Control of Insects Research Laboratory	Missouri	Columbia
USDA	ARS	Carl Hayden Bee Research Center	Arizona	Tucson
USDA	ARS	Center for Medical, Agricultural, and Veterinary Entomology	Florida	Gainesville
USDA	ARS	Central Great Plains Research Station	Colorado	Akron
USDA	ARS	Cereal Crops Research Unit	Wisconsin	Madison
USDA	ARS	Children's Nutrition Research Center	Texas	Houston
USDA	ARS	Coastal Plains Soil, Water & Plant Research Center	South Carolina	Florence
USDA	ARS	Columbia Plateau Conservation Research Center	Oregon	Pendleton
USDA	ARS	Conservation and Production Research Laboratory	Texas	Bushland
USDA	ARS	Cotton Quality Research Station	South Carolina	Clemson
USDA	ARS	Crop Genetic and Environmental Research Laboratory	Florida	Gainesville
USDA	ARS	Cropping Systems Research Laboratory	Texas	Lubbock
USDA	ARS	Crops Research Laboratory	Colorado	Fort Collins
USDA	ARS	Dale Bumpers Small Farms Research Center	Arkansas	Booneville
USDA	ARS	Eastern Oregon Agricultural Research Center	Oregon	Burns
USDA	ARS	Eastern Regional Research Center	Pennsylvania	Wyndmoor
USDA	ARS	Fish Diseases and Parasites Research Laboratory	Alabama	Auburn
USDA	ARS	Forage and Range Research Laboratory	Utah	Logan
USDA	ARS	Foreign Disease-Weed Science Research Laboratory	Maryland	Frederick
USDA	ARS	Fort Keogh Livestock and Range Research Laboratory	Montana	Miles City
USDA	ARS	Georgia Coastal Plain Experiment Station	Georgia	Tifton
USDA	ARS	Grain Marketing and Production Research Center	Kansas	Manhattan
USDA	ARS	Grand Forks Human Nutrition Research Center	North Dakota	Grand Forks
USDA	ARS	Grassland, Soil, and Water Research Laboratory	Texas	Temple
USDA	ARS	Grazinglands Research Laboratory	Oklahoma	El Reno
USDA	ARS	High Plains Grasslands Research Station	Wyoming	Cheyenne
USDA	ARS	Honeybee, Soil and Water Research Laboratory	Louisiana	Baton Rouge
USDA	ARS	Horticultural Crops Research Laboratory	California	Fresno
USDA	ARS	Human Nutrition Research Center on Aging	Massachusetts	Boston
USDA	ARS	Insect Biology and Population Management Research Laboratory	Georgia	Tifton
USDA	ARS	Irrigated Agriculture Research and Extension Center	Washington	Prosser
USDA	ARS	Jamie Whitten Delta States Research Center	Mississippi	Stoneville

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
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USDA	ARS	Jornada Experimental Range	New Mexico	Las Cruces
USDA	ARS	Knippling-Bushland Laboratory	Texas	Kerrville
USDA	ARS	Landscape Ecology of Temperate Desert Rangelands Laboratory	Nevada	Reno
USDA	ARS	Mississippi State Research Center	Mississippi	Starkville
USDA	ARS	National Animal Disease Center	Iowa	Ames
USDA	ARS	National Aquaculture Research Center	Arkansas	Stuttgart
USDA	ARS	National Center for Agricultural Utilization Research	Illinois	Peoria
USDA	ARS	National Center for Cool and Cold Water Aquaculture	West Virginia	Leetown
USDA	ARS	National Clonal Germplasm Repository	Oregon	Corvallis
USDA	ARS	National Clonal Germplasm Repository for Citrus	California	Riverside
USDA	ARS	National Forage Seed Protection and Testing Center	Oregon	Corvallis
USDA	ARS	National Peanut Research Laboratory	Georgia	Dawson
USDA	ARS	National Rice Germplasm Evaluation and Enhancement Center	Arkansas	Stuttgart
USDA	ARS	National Sedimentation Laboratory	Mississippi	Oxford
USDA	ARS	National Seed Storage Laboratory	Colorado	Fort Collins
USDA	ARS	National Soil Dynamics Laboratory Unit	Alabama	Auburn
USDA	ARS	National Soil Tilth Laboratory	Iowa	Ames
USDA	ARS	Natural Products Utilization Research Unit	Mississippi	Oxford
USDA	ARS	Natural Resources Research Center	Colorado	Fort Collins
USDA	ARS	North Appalachian Experimental Watershed Research Unit	Ohio	Coshocton
USDA	ARS	North Central Soil Conservation Research Laboratory	Minnesota	Morris
USDA	ARS	Northern Grain Insects Research Laboratory	South Dakota	Brookings
USDA	ARS	Northern Great Plains Research	North Dakota	Mandan
USDA	ARS	Northern Plain Soil and Water Research Laboratory	Montana	Sidney
USDA	ARS	Northwest Irrigation and Soils Research Laboratory	Idaho	Kimberly
USDA	ARS	Northwest Watershed Research Center	Idaho	Boise
USDA	ARS	Palouse Conservation Field Station	Washington	Pullman
USDA	ARS	Pasture Systems and Watershed Management Research Laboratory	Pennsylvania	University Park
USDA	ARS	Plant Disease Resistance Research Laboratory	Wisconsin	Madison
USDA	ARS	Plant Gene Expression Center	California	Albany
USDA	ARS	Plant Genetic Resources Unit	New York	Geneva
USDA	ARS	Plant Science and Water Conservation Research Laboratory	Oklahoma	Stillwater
USDA	ARS	Plum Island Animal Disease Center	New York	Greenport
USDA	ARS	Poultry and Food Science Research Laboratory	Arkansas	Fayetteville
USDA	ARS	Red River Valley Agricultural Research Center	North Dakota	Fargo
USDA	ARS	Regional Plant Introduction Station	Georgia	Griffin
USDA	ARS	Rice Research Laboratory	Texas	Beaumont
USDA	ARS	Richard B. Russell Agricultural Research Center	Georgia	Athens
USDA	ARS	Roman L. Hruska U.S. Meat Animal Research Center	Nebraska	Clay Center
USDA	ARS	Small Grains and Potato Germplasm Research Laboratory	Idaho	Aberdeen
USDA	ARS	Soil Drainage Research Unit	Ohio	Columbus
USDA	ARS	South Central Agricultural Research Laboratory	Oklahoma	Lane
USDA	ARS	Southeast Poultry Research Laboratory	Georgia	Athens
USDA	ARS	Southeastern Fruit and Tree Nut Research Laboratory	Georgia	Byron
USDA	ARS	Southern Plains Agricultural Research Center	Texas	College Station
USDA	ARS	Southern Plains Range Research Station	Oklahoma	Woodward
USDA	ARS	Southern Regional Research Center	Louisiana	New Orleans
USDA	ARS	Southwest Watershed Research Center	Arizona	Tucson
USDA	ARS	Southwestern Cotton Ginning Research Laboratory	New Mexico	Mesilla Park
USDA	ARS	Subtropical Agricultural Research Station	Florida	Brooksville
USDA	ARS	Subtropical Agriculture Research Center	Texas	Weslaco
USDA	ARS	Subtropical Horticultural Research Laboratory	Florida	Miami
USDA	ARS	Tree Fruit Research Laboratory	Washington	Wenatchee
USDA	ARS	Tropical Agriculture Research Station	Puerto Rico	Mayaguez
USDA	ARS	U.S. Agricultural Research Station	California	Salinas
USDA	ARS	U.S. Citrus and Subtropical Products Laboratory	Florida	Winter Haven
USDA	ARS	U.S. Dairy Forage Research Center	Wisconsin	Madison
USDA	ARS	U.S. Horticultural Research Laboratory	Florida	Orlando
USDA	ARS	U.S. National Arboretum	District of Columbia	
USDA	ARS	U.S. Pacific Basin Agricultural Research Center	Hawaii	Hilo
USDA	ARS	U.S. Plant, Soil, and Nutrition Laboratory	New York	Ithaca
USDA	ARS	U.S. Salinity Laboratory	California	Riverside
USDA	ARS	U.S. Sheep Experiment Station	Idaho	Dubois
USDA	ARS	U.S. Small Fruits Research Station	Mississippi	Poplarville

FEDERAL IN-HOUSE R&D ACTIVITIES BY AGENCY 645

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
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USDA	ARS	U.S. Sugarcane Field Station	Florida	Canal Point
USDA	ARS	U.S. Vegetable Laboratory	South Carolina	Charleston
USDA	ARS	U.S. Water Conservation Laboratory	Arizona	Phoenix
USDA	ARS	Vegetable Crops Research Laboratory	Wisconsin	Madison
USDA	ARS	Water Management Research Laboratory	California	Fresno
USDA	ARS	Western Cotton Research Laboratory	Arizona	Phoenix
USDA	ARS	Western Human Nutrition Research Center	California	Davis
USDA	ARS	Western Integrated Cropping Systems Research Unit (Shafter Research Laboratory)	California	Shafter
USDA	ARS	Western Regional Research Center	California	Albany
USDA	ARS	Yakima Agricultural Research Laboratory	Washington	Yakima
USDA	CSREES	Cooperative Research, Extension, and Education Service Headquarters	District of Columbia	
USDA	FS	Albuquerque Forestry Sciences Laboratory	New Mexico	Albuquerque
USDA	FS	Aldo Leopold Wilderness Research Institute	Montana	Missoula
USDA	FS	Alexandria Forestry Center	Louisiana	Pineville
USDA	FS	Anchorage Forestry Sciences Laboratory	Alaska	Anchorage
USDA	FS	Arkansas Forestry Sciences Work Site	Arkansas	Monticello
USDA	FS	Boise Forestry Sciences Laboratory	Idaho	Boise
USDA	FS	Bozeman Forestry Sciences Laboratory	Montana	Bozeman
USDA	FS	Center for Forested Wetlands	South Carolina	Charleston
USDA	FS	Corvallis Forestry Sciences Laboratory	Oregon	Corvallis
USDA	FS	Coweeta Hydrologic Laboratory	North Carolina	Otto
USDA	FS	Delaware Forestry Sciences Laboratory	Ohio	Delaware
USDA	FS	Durham Forestry Science Laboratory	New Hampshire	Durham
USDA	FS	East Lansing Forestry Sciences Laboratory	Michigan	East Lansing
USDA	FS	Fairbanks Forestry Sciences Work Site	Alaska	Fairbanks
USDA	FS	Fires Sciences Laboratory	Montana	Missoula
USDA	FS	Flagstaff Forestry Sciences Laboratory	Arizona	Flagstaff
USDA	FS	Forest Service Research and Development Office	District of Columbia	
USDA	FS	Forestry Science Laboratory	Georgia	Athens
USDA	FS	Fresno Forestry Sciences Laboratory	California	Fresno
USDA	FS	G.W. Andrews Forestry Sciences Laboratory	Alabama	Auburn
USDA	FS	George D. Aiken Forestry Sciences Laboratory	Vermont	Burlington
USDA	FS	Institute of Forest Genetics	California	Davis
USDA	FS	Institute of Pacific Islands Forestry	Hawaii	Honolulu
USDA	FS	International Institute of Tropical Forestry	Puerto Rico	Rio Piedras
USDA	FS	Juneau Forestry Sciences Laboratory	Alaska	Juneau
USDA	FS	LaGrande Forestry and Range Sciences Laboratory	Oregon	La Grande
USDA	FS	Laramie Forestry Science Laboratory	Wyoming	Laramie
USDA	FS	Legal Tax and Economic Influences on Forest Resource Management Work Site	Louisiana	New Orleans
USDA	FS	Logan Forestry Sciences Laboratory	Utah	Logan
USDA	FS	Madison Forests Products Laboratory	Wisconsin	Madison
USDA	FS	Missoula Forestry Sciences Laboratory	Montana	Missoula
USDA	FS	Morgantown Forestry Sciences Laboratory	West Virginia	Morgantown
USDA	FS	Moscow Forestry Sciences Laboratory	Idaho	Moscow
USDA	FS	National Agroforestry Research Center	Nebraska	Lincoln
USDA	FS	Newton Square Forestry Sciences Laboratory	Pennsylvania	Newton Square
USDA	FS	North Central Forest Experiment Station Headquarters	Minnesota	St. Paul
USDA	FS	Northeastern Center for Forest Health Research	Connecticut	Hamden
USDA	FS	Ogden Forestry Laboratory	Utah	Ogden
USDA	FS	Olympia Forestry Sciences Laboratory	Washington	Olympia
USDA	FS	Pacific Northwest Research Station Headquarters	Oregon	Portland
USDA	FS	Pacific Southwest Research Station Headquarters	California	Albany
USDA	FS	Princeton Forestry Sciences Laboratory	West Virginia	Princeton
USDA	FS	R&D Work Site of North Central Forest Experiment Station	Wisconsin	Rhineland
USDA	FS	R&D Work Site of Northeastern Research Station	Massachusetts	Amherst
USDA	FS	R&D Work Site of Southern Research Station	North Carolina	Raleigh
USDA	FS	R&D Work Site of Southern Research Station	South Carolina	Clemson
USDA	FS	R&D Work Site of Southern Research Station	Virginia	Blacksburg
USDA	FS	R&D Worksite of North Central Forest Experiment Station	Illinois	Evanston
USDA	FS	R&D Worksite of North Central Forest Experiment Station	Michigan	Houghton
USDA	FS	R&D Worksite of North Central Forest Experiment Station	Minnesota	Grand Rapids
USDA	FS	R&D Worksite of North Central Forest Experiment Station	Missouri	Columbia

Federal Agency	Bureau Within Federal Agency	Federal R&D Unit	State	City
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USDA	FS	Rapid City Forestry Sciences Laboratory	South Dakota	Rapid City
USDA	FS	Redding Silviculture Laboratory	California	Redding
USDA	FS	Redwood Sciences Laboratory	California	Arcata
USDA	FS	Reno Forestry Science Laboratory	Nevada	Reno
USDA	FS	Research Triangle Park Forestry Sciences Laboratory	North Carolina	Research Triangle Park
USDA	FS	Riverside Forest Fire Laboratory	California	Riverside
USDA	FS	Rocky Mountain Research Station Headquarters	Colorado	Fort Collins
USDA	FS	Seattle Forestry Sciences Laboratory	Washington	Seattle
USDA	FS	Shrub Sciences Laboratory	Utah	Ogden
USDA	FS	Southern Hardwoods Laboratory	Mississippi	Stoneville
USDA	FS	Southern Institute of Forest Genetics	Mississippi	Saucier
USDA	FS	Southern Research Station Headquarters	North Carolina	Asheville
USDA	FS	Starkville Forestry Sciences Laboratory	Mississippi	Starkville
USDA	FS	Timber and Watershed Laboratory	West Virginia	Parsons
USDA	FS	Urban and Community Ecosystem Research Unit Laboratory	New York	Syracuse
USDA	FS	Warren Forestry Sciences Laboratory	Pennsylvania	Warren
USDA	FS	Wenatchee Forestry Sciences Laboratory	Washington	Wenatchee
USDA	FS	Western Center for Urban Forest Research and Education	California	Davis
USDA	FS	Wildlife Habitat and Silviculture Laboratory	Texas	Nacogdoches
USDA	FS	Wood Utilization Center	Alaska	Sitka

Discovery and Innovation

Federal Research and Development Activities in the Fifty States, District of Columbia, and Puerto Rico

The importance and value of research and development (R&D) is universally recognized. R&D has a profound impact on every aspect of our lives—affecting the air we breath, the food we eat, and the water we drink; the ailments we suffer; the way we communicate; and the manner in which we traverse our cities, our planet, and beyond. This national investment in our future also has a major effect on the economy, because entire industries—transportation, pharmaceuticals, computers, telecommunications—are rooted in R&D and its continuing output.

The local and regional impacts of federal R&D activities are equally important and of direct consequence to all Americans. Little wonder that states and localities compete with each other to attract federal R&D support to their jurisdictions.

This report, based largely on the RaDiUS database developed by RAND, allows policymakers and the public for the first time to break down the complex federal R&D portfolio into its component state and local elements. It details the full range of federal R&D activities in terms of the individual laboratories, centers, universities, and companies performing the research, doing the studies, and conducting the analyses. It reveals that virtually every community in the nation has a direct stake in the federal R&D enterprise.

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